UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA

Facultad de Economía, Empresa y Turismo

Tesis Doctoral

AIRPORT MOBILE INTERNET

Luis Martín Domingo

Estambul / Istanbul – Oct 2015

Página para uso de los servicios administrativos de la Universidad

Anexo I

DÑA. ROSA M. BATISTA CANINO, VICEDECANA DE POSGRADO Y FORMACIÓN CONTINUA DE LA FACULTAD DE ECONOMÍA, EMPRESA Y TURISMO DE LA UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA, EN CALIDAD DE PRESIDENTE DE LA COMISIÓN DE DOCTORADOS EN EXTINCIÓN

CERTIFICA,

Que la citada Comisión en su sesión de fecha 04 de noviembre de 2015 tomó el acuerdo de dar el consentimiento para su tramitación, a la tesis doctoral titulada "**Airport Mobile Internet**" presentada por el doctorando **D. Luis Martín Domingo** y dirigida por el Doctor **Juan C. Martín Hernández.**

Y para que así conste, y a efectos de lo previsto en el Artº 6 del Reglamento para la elaboración, defensa, tribunal y evaluación de tesis doctorales de la Universidad de Las Palmas de Gran Canaria, firmo la presente en Las Palmas de Gran Canaria, a 4 de noviembre de dos mil quince.

UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA

Facultad: **Economía, Empresa y Turismo**

Programa de Doctorado: **Perspectivas Científicas sobre el Turismo y la Dirección de Empresas Turísticas**

Título de la Tesis:

AIRPORT MOBILE INTERNET

Tesis Doctoral presentada por: **D. Luis Martín Domingo**

Dirigida por el Dr.: **D. Juan Carlos Martín Hernández**

El Director
Firma

El **Doctorando**
Firma

Las Palmas de Gran Canaria a 2 de noviembre de 2015

Estambul a 31 de octubre de 2015

AGRADECIMIENTOS | ACKNOWLEDGEMENTS

Mi mayor agradecimiento es tanto para mi supervisor Juan Carlos Martín, que me invitó a realizar un doctorado en la Universidad de Las Palmas en el año 2009 como para mi mujer Dominique, que había conocido un año antes a pie de la Muralla China. Especialmente ambos, pero también otros muchos me han animado y apoyado durante todo este viaje y quiero deciros: Gracias, Mercie, Thank you, 谢谢 (xie xie), Teşekkürler,…

En junio de 2009 me ponía en contacto con Juan Carlos vía email, desde mi ”home office” en Pekín mientras trabajaba para la compañía Fraport y también seguía peleándome con los caracteres chinos. Una noticia en la prensa cuestionaba la eficiencia del sistema aeroportuario español en algunas regiones como por ejemplo la gallega, con tres aeropuertos y se basaba en un artículo de investigación (Martín, Román, & Voltes-Dorta, 2009). En dicho contacto a puerta fría, le solicitaba una copia del artículo mencionado y también le mencionaba mi interés en hacer un doctorado a tiempo parcial. La última contestación que había tenido a dicha pregunta había sido cinco años antes, mientras trabajaba para la compañía Spanair, y había sido: "*Tú tienes que dedicar a tu trabajo aquí el 120% de tu tiempo*" (no hay tiempo para doctorado)…. Así, que me costó un tiempo en lanzarme y hacer la pregunta de nuevo. En este caso me encontré con una contestación extremadamente amable e inspiradora por parte de Juan Carlos. Junto con la copia del artículo solicitado, me decía: "*Yo estaría encantado de que hicieras un doctorado aquí con nosotros*". Dicha contestación me hizo muchísima ilusión y podría decirse que representa la entrada al aeropuerto de Pekín para tomar un "vuelo" dirección a Las Palmas de Gran Canaria.

Dicho vuelo dispuesto con conexión WiFi en casi todo su trayecto me ha permitido tanto mantener el contacto con Las Palmas de Gran Canaria, como realizar una gran parte de esta investigación. Al mismo tiempo, varios son los viajeros a los que quiero agradecer su colaboración en este trayecto.

Gracias a la Universidad de Las Palmas por permitirme realizar este doctorado desde la distancia.

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Gracias a Julio por enseñarme la diferencia entre que haya oro debajo de una piedra a que haya oro debajo de las piedras marrones, de tamaño medio y localizadas entre los 800 y 900 metros de altitud.

Gracias a Novatronic Sistemas por regalarme el primer iPhone con el que puede recoger datos de sitios web móviles y App de aeropuertos de todo el mundo.

Gracias Nuria y Enrique por darme la oportunidad de comenzar a dar clases en ESEUNE China, mientras estaba a bordo de este vuelo.

Gracias a mi familia de España por estar siempre ahí. Especial mención a Germán, por no cesar en preguntarme: *Luis, ¿Cómo va la tesis?*

Mercie aussi à la famille de la France, en particulier Monsieur et Madame Montagnon.

Thank you Hatice Hocam, for accepting me and also to the rest of colleagues for supporting me on this stop-over in Istanbul.

Thank you to Kayla Friedman and Malcolm Morgan of the Centre for Sustainable Development, University of Cambridge, UK for producing the Microsoft Word thesis template used to produce this document.

En estos momentos el vuelo con origen en Pekín está llegando a su destino en el aeropuerto de Gran Canaria. Dominique, sigue en el asiento de al lado (el de la ventana) y Juan Carlos, haciendo uso de la conexión a internet, continúa haciendo un seguimiento cercano del vuelo. Muchas gracias. La App del aeropuerto de Gran Canaria anuncia: el vuelo procedente de Pekín acaba de aterrizar.

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1 INTRODUCCIÓN Y RESUMEN

Resumen general de la tesis

Los aeropuertos se enfrentan a diferentes retos entre los que se encuentran: Cómo guiar a sus pasajeros hasta, desde y dentro de sus terminales; seguir aumentando los ingresos comerciales y proporcionar una buena calidad de servicio. Al mismo tiempo, internet ha cambiado la forma de hacer negocios en muchas industrias, incluyendo la industria aeroportuaria y ahora más del 80% de los pasajeros viajan con dispositivos móviles con acceso a internet. El objetivo de la tesis es la de analizar la adopción por parte de los aeropuertos de sitios web y Apps para dispositivos móviles, identificar aeropuertos que son realmente innovadores y analizar si los servicios móviles de internet que proveen contribuyen a superar algunos de los desafíos a los que los aeropuertos se enfrentan.

Esta investigación toma como muestra algunos de los aeropuertos más grandes del mundo y los analiza desde un laboratorio. Utiliza un modelo teórico de innovación para averiguar si los aeropuertos que adoptan pronto los servicios de internet móviles pueden considerarse realmente innovadores. Recurre a modelos de evaluación de sitios web, sitios web para móviles y Apps dentro de la investigación en turismo y los adapta para sector de aeropuertos.

Los resultados muestran que los aeropuertos están adoptando estos servicios móviles de internet (69% en enero de 2014), pero a un ritmo más lento que otras industrias de turismo y transporte, tales como hoteles o aerolíneas. Los servicios móviles de internet de los aeropuertos incluyen principalmente servicios de información, pero ofrecen una funcionalidad limitada de venta e información orientadas a incrementar los ingresos comerciales. La adopción temprana de servicios de internet móvil por parte de los aeropuertos no parece estar relacionada con su tamaño, pero si con los ingresos comerciales y la ubicación geográfica. Entre los aeropuertos norteamericanos y europeos existe una mayor probabilidad de encontrar uno que ofrezca servicios de internet móvil y cuatro aeropuertos europeos fueron considerados realmente innovadores (Londres Heathrow, Londres Stansted, Amsterdam Schiphol y Copenhague).

Palabras clave: Aeropuerto, web, móvil, App, ingresos comerciales, calidad de servicio

1.1 Motivación y objetivos

Airport Mobile Internet se refiere a los servicios de internet prestados por los aeropuertos para servir a los pasajeros que viajan con dispositivos móviles con internet y que se representa de forma gráfica a continuación (ver Figure 1-1). Esos servicios incluyen sitios web para dispositivos móviles y aplicaciones (Apps). Esta investigación analiza la adopción por parte de los aeropuertos de estos nuevos servicios, así como su contenido.

Figure 1-1. Airport mobile Internet[1]

El transporte aéreo es una industria muy dinámica, la demanda de los pasajeros aéreos se ha duplicado en los últimos 15 años, llegando a más de 3 mil millones en 2014 (ATAG, 2014) y se espera que el número de pasajeros se duplique de nuevo en los próximos 15 años (Airbus, 2014). Todos esos pasajeros deben usar algunos de los 4000 aeropuertos repartidos por todo el mundo durante sus viajes.

[1] Todas las figuras han sido creadas por el autor si no se indica lo contrario

Figure 1-2. Tráfico aéreo medido en RPK[2] (Airbus, 2014)

Los aeropuertos han evolucionado, partiendo de entidades públicas han pasado a ser en muchos casos organizaciones con intereses comerciales y en algunos casos a ser privatizados. Los aeropuertos comerciales tienen ahora una presión creciente por partida doble, de sus clientes las aerolíneas para que mantengan unos precios competitivos y de sus accionistas para ser rentables. Una forma de complacer ambos intereses ha sido el aumento de los ingresos comerciales (Graham, 2009).

Los aeropuertos han tenido que ampliar sus instalaciones para servir la nueva demanda creciente de pasajeros (Budd, Ison, & Ryley, 2011). Durante ese proceso de ampliación y con el fin de aumentar los ingresos comerciales, los aeropuertos han hecho crecer más sus zonas comerciales que el incremento de

[2] RPK responde al término "Revenue Passenger Kilometer" en sus siglas en inglés. Es una unidad para medir el volumen de tráfico de pasajeros transportado por de las compañías aéreas y que tiene en cuenta la distancia transportada. RPK se calcula multiplicando el número de "Revenue Passenger" (RP) por el número de kilómetros transportados. RP es un pasajero por el que una compañía aérea recibe remuneración comercial a cambio del servicio de transporte. Esta medida excluye aquellos pasajeros que viajan con tarifas muy económicas que solo están disponibles para los empleados o familiares, así como bebes y niños (0-2 años) que no disponen de un sitio (Moneyterms, 2015).

la demanda. Por ejemplo, durante el período 1990-2008 los aeropuertos de Heathrow, Gatwick, Stansted y Glasgow en el Reino Unido aumentaron en un 150 por ciento el espacio comercial (Graham, 2009), mientras que el número de pasajeros sólo aumentó en un 98 por ciento (CAA UK, 2009). Por lo tanto, la opción que tienen los aeropuertos de aumentar su densidad de superficie comercial en sus terminales está ahora más limitada (Graham, 2009) y la complejidad a la que se enfrentan los pasajeros mientras cruzan la terminal del aeropuerto ha aumentado (Manataki & Zografos, 2009).

Los profundos cambios estructurales observados en la industria aeroportuaria, tales como la comercialización, la privatización, la globalización y la competencia han animado a los aeropuertos a poner más énfasis en la calidad (Graham, 2013). La calidad del servicio de los aeropuertos (ASQ en sus siglas en inglés) es también un buen indicador tanto para la industria turística como para la imagen de un destino en particular, ya que por lo general el primer contacto del turista con un destino viene a través del aeropuerto (Fernandes & Pacheco, 2008; Rendeiro Martín-Cejas, 2006).

Teniendo en cuenta las consideraciones anteriores los aeropuertos se enfrentan, entre otros, a los siguientes retos:

- Seguir aumentando los ingresos comerciales
- Guiar a los pasajeros a lo largo de la terminal del aeropuerto
- Reducir la congestión y contaminación en los accesos al aeropuerto
- Proporcionar una buena calidad de servicio en el aeropuerto (ASQ)

Al mismo tiempo, durante los últimos 15 años, internet ha cambiado la forma de hacer negocios en muchas industrias, incluyendo la industria del turismo (Ho & Lee, 2007). Desde el 2000 hasta el 2015 el número de usuarios de internet en todo el mundo ha aumentado casi 10 veces, pasando de 360 millones a 3,2 mil millones de usuarios – ver Figure 1-3- (Internet Worldstats, 2015). Una tendencia más reciente es el acceso a internet a través de dispositivos móviles.

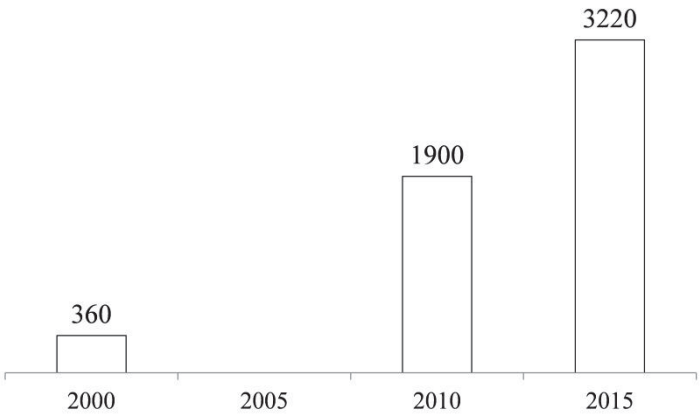

Figure 1-3. Usuarios mundiales de internet en millones (Internet Worldstats, 2015)

Internet en dispositivos móviles comenzó a utilizarse en Japón a finales de la década de 1990s, pero no ganó popularidad en la búsqueda de información de viajes hasta finales de los 2000s (Okazaki & Hirose, 2009). Un hito importante fue el lanzamiento del primer iPhone en 2007 (Apple, 2007). El año 2009 vio algunos de los primeros aeropuertos adoptando los servicios de internet móvil. Por ejemplo, el aeropuerto internacional de Dallas / Fort Worth en los EE.UU. presentó su primer sitio web para móviles (DFW, 2009) y Aéroports de Paris en Francia su primer iPhone App (Aéroports de Paris, 2009). La Figure 1-4 muestra la App de Aéroports de Paris para un dispositivo iPhone en su versión 8.1 (Aéroports de Paris, 2015).

La App de Aéroports de Paris que se muestra en la Figure 1-4 ha sido actualizada en 20 ocasiones, después que fuera lanzada por primera vez en 2009 (Aéroports de Paris, 2015). Dichas actualizaciones pretenden mejorar el servicio a los pasajeros que disponen de un dispositivo móvil con acceso a internet y deciden instalarlas. En ese sentido, la penetración del número de pasajeros aéreos que viajan con teléfonos móviles no ha parado de aumentar en los últimos seis años; alcanzando el 81% en 2014 (véase la Figure 1-5).

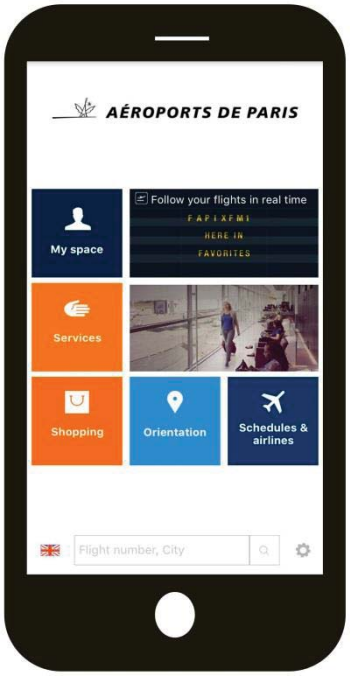

Figure 1-4. iPhone App de Aéroports de Paris - Oct 2015 (Aéroports de Paris, 2015)

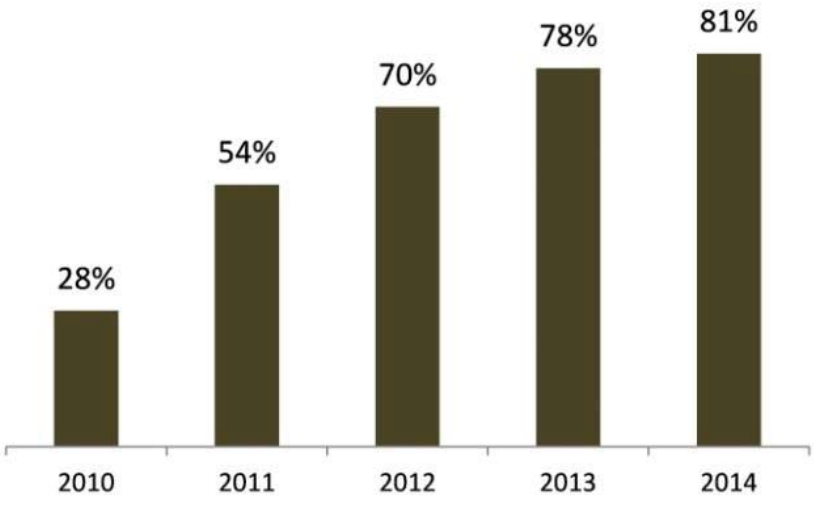

Figure 1-5. Porcentaje de pasajeros viajando con móviles inteligentes basado en datos de SITA (2012, 2013, 2014b, 2015)

El objetivo de esta tesis es analizar cómo estos nuevos servicios de internet móviles están contribuyendo a superar algunos de los desafíos a los que se enfrentan los aeropuertos. Al mismo tiempo, se pretende iniciar una nueva línea de investigación en el campo de la gestión aeroportuaria. Siendo más específico:

- ¿Están los aeropuertos adoptando activamente estos nuevos servicios móviles de internet?
- ¿Contribuyen estos nuevos servicios a aumentar la calidad de servicios de los aeropuertos (ASQ) y, en particular a guiar a los pasajeros dentro y fuera de la terminal del aeropuerto, a la vez que desarrollan los ingresos comerciales?

Los objetivos de esta investigación pretendían desde el principio ir más allá del análisis de adopción y servicios de internet móvil de los aeropuertos. El autor consideraba que, además de adquirir las habilidades de investigación académica necesarias, era importante tratar de establecer vínculos entre el campo de la investigación y la industria aeroportuaria, así como de explorar herramientas tecnológicas que pudieran ayudarle, no sólo a llevar a cabo la investigación, sino también a difundirla.

Dentro del campo de la investigación académica y con el fin de completar un programa de doctorado es necesario realizar una investigación original. En este caso particular, teniendo en cuenta algunos de los desafíos a los que se enfrentan los aeropuertos, junto con los servicios de internet móvil provistos por los aeropuertos, los objetivos son:

- Estudiar la adopción de sitios web para móviles y Apps móviles por parte de los aeropuertos a lo largo del tiempo.
- Evaluar estos nuevos servicios móviles desde diferentes punto de vista: Momento de adoptarlos, Forma de implementarlos, Alcance y calidad del servicio y la calidad de servicio del aeropuerto (ASQ)

Al llevar a cabo esta investigación, el autor pretendía adquirir las habilidades de investigación necesarias para llevar a cabo una investigación independiente. Pero también, una parte importante de la investigación academia es ser capaz

de comunicar el conocimiento adquirido. Este hecho a menudo se produce dentro de un aula. Por lo tanto, otro objetivo fue:

- Realizar la investigación académica (a tiempo parcial) mientras se impartían clases en la universidad.

Instituciones europeas a través de diferentes programas han tratado de estimular los vínculos entre la investigación academia y la industria. Por ejemplo, en 2006, un grupo combinado de expertos de la industria, instituciones e institutos de investigación de los Estados miembros de la UE definieron doce recomendaciones para promover la movilidad de los investigadores entre el mundo académico y la industria (EU Research, 2006). En los EE.UU., el *Airport Cooperative Research Program* (ACRP, 2015) utiliza la investigación para tratar de resolver los problemas de los aeropuertos.

El autor tenía más de 10 años de experiencia trabajando en la industria del transporte aéreo antes de comenzar este programa de doctorado en 2010. Él está convencido, y esa fue una de las razones importantes que le empujaron a comenzarlo, que debe existir una relación más estrecha entre la industria y la investigación academia.

Los objetivos, que tenían como propósito desarrollar vínculos entre la investigación academia y la industria aeroportuaria, fueron:

- Tratar de establecer una cooperación con un aeropuerto que pudiera estar interesado en la investigación sobre los servicios de internet móvil.
- Definir y llevar a cabo una investigación en este campo que le fuera de interés al aeropuerto y que fuera compatible con los requisitos académicos del programa de doctorado.

La investigación académica requiere del manejo de un número mínimo de herramientas, incluso para completar un programa de doctorado. Por ejemplo, el uso de un procesador de texto para escribir un documento como éste. Sin embargo, hay otras herramientas que no son estrictamente necesarias, pero pueden contribuir a facilitar la investigación y la difusión del conocimiento investigado.

Además, el tema de investigación que aquí se trata - servicios de internet para dispositivos móviles - implica una nueva tecnología que puede utilizarse no sólo por los aeropuertos, pero también en otros campos como el de la investigación académica. Por ejemplo, puede utilizarse un dispositivo móvil con acceso a internet para leer un artículo de investigación, sin embargo, el documento de dicho archivo preferiblemente debería estar en un formato adecuado para dispositivos móviles como EPUB (IDPF, 2015) o MOBI en caso de un dispositivo Kindle. En este contexto, el siguiente objetivo fue definido:

- Utilizar algunas de las nuevas herramientas tecnológicas que facilitan el proceso de investigación y pueden contribuir a difundir el conocimiento.

1.2 Metodología

El entorno de internet móvil ha cambiado muy rápidamente como se describe en la sección 1.1. Estos rápidos cambios ya se preveían cuando se comenzó esta investigación en 2011. Así que se decidió realizar esta tesis mediante el compendio de artículos científicos separados.

La metodología de investigación se encamina a la consecución de los objetivos definidos en la sección anterior. Cada uno de los cuatro artículos incluidos (capítulo 3, capítulo 4, capítulo 5 y capítulo 6), contiene la metodología detallada utilizada en cada caso, y en esta sección se ofrece una visión general de las metodologías utilizadas. Además, incluye la estrategia de investigación utilizada para tratar de establecer vínculos con la industria aeroportuaria, así como dos de las herramientas tecnológicas utilizadas durante la investigación. La investigación académica ha estado utilizando métodos de evaluación[3] para

[3] La evaluación de sitios web puede definirse como “the act of determining a correct and comprehensive set of requirements, ensuring that a website provides useful content that meets user expectations and setting usability goals” (Law, Qi, & Buhalis, 2010, p. 297). Esta definición puede traducirse como “el acto de identificar una serie de necesidades, comprobar

sitios web desde mediados de la década de 1990 en diferentes campos (Chiou, Lin, & Perng, 2010). Esta técnica se ha aplicado a distintos sitios web de la industria del turismo y Law et al. (2010) identificaron los siguientes sectores: hoteles, destinos, proveedores de viajes, aerolíneas, guías de viajes en línea, revistas de viajes en línea, buscadores de viajes y blogs de viajes. Sin embargo, la evaluación de sitios web, sitios web para dispositivos móviles y Apps de aeropuertos no se encontraron.

La metodología utilizada para evaluar sitios web, sitios web para dispositivos móviles y Apps de los aeropuertos ha sido la de adaptar modelos de investigación utilizados en el área del turismo, al contexto aeroportuario. Esto se representa gráficamente en la Figure 1-6.

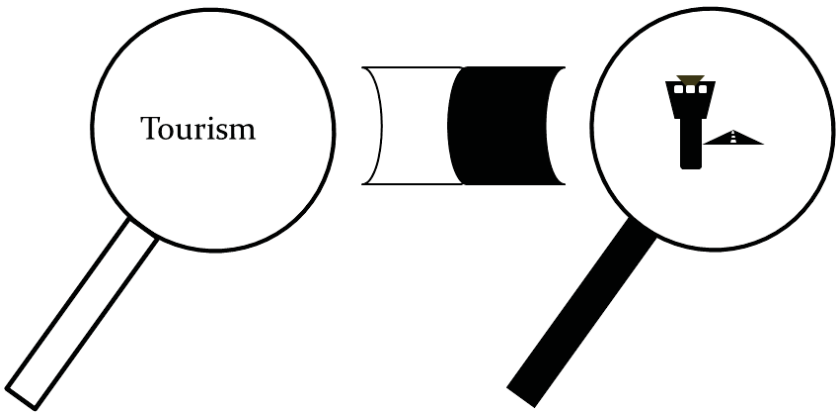

Figure 1-6. Modelos de evaluación de sitios web y Apps del turismo adaptados a los aeropuertos

En el capítulo 3 con el fin de evaluar sitios web para dispositivos móviles de aeropuertos se tomaron tres de los factores de éxito utilizados por Chiou et al. (2010) y basados en una revisión de artículos sobre la evaluación de sitios web por Park and Gretzel (2007): Fácil acceso al sitio, la calidad de la información

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que el sitio web ofrece un contenido útil que satisfaga las expectativas de los usuarios y definir los objetivos de usabilidad"

y la persuasión de su información comercial, se evaluaron 22 sitios web para dispositivos móviles de aeropuertos de distintas regiones del mundo. En el capítulo 4 dos de los factores (fácil acceso al sitio y persuasión) se utilizaron para evaluar tanto sitios web como sitios web para dispositivos móviles. En el capítulo 5 se evaluaron 31 aplicaciones móviles (Apps) para dispositivos móviles iPhone de algunos de los mayores aeropuertos europeos. En este caso, se tomó como base el modelo que Scolari y Fernández-Cavia (2014) habían desarrollado para la evaluación de Apps móviles de destinos turísticos. Este se adaptó para la evaluación de los servicios de acceso al aeropuerto por superficie en las Apps de los aeropuertos.

En el Capítulo 4, además de evaluar los sitios de internet para dispositivos móviles y con el fin de identificar aeropuertos innovadores, se define un modelo teórico que se apoya en la teoría de la adopción de la innovación desarrollada por Rogers (1995). Dicha teoría tiene en cuenta sólo el momento en que las organizaciones adoptan una innovación y parece no ser suficiente de acuerdo a Frambach & Schillewaert (2002) y Tornatzky & Klein (1982). Así que el modelo definido (ver Figure 1-7) incluye además del momento de adopción de la innovación, el grado de implementación o sofisticación. Este modelo es aplicado a los sitios web, sitios web para dispositivos móviles y Apps de 75 aeropuertos de los más grandes de todo el mundo. El modelo define los aeropuertos como realmente innovadores, cuando se identifican como innovadores en dos procesos de innovación (adopción del sitio web para PC y adopción de servicios para dispositivos móviles con internet en este caso).

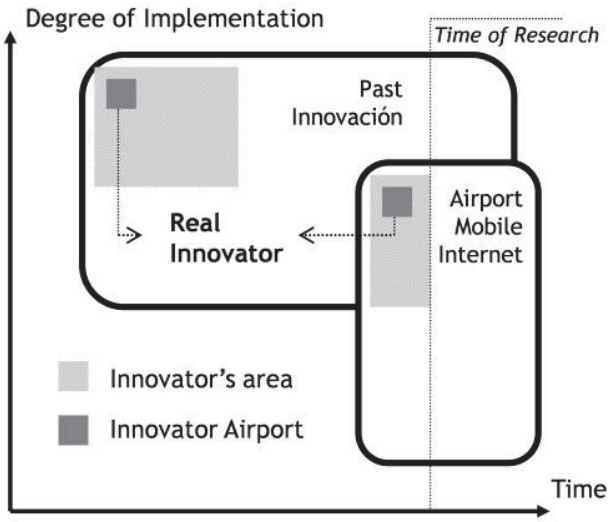

Figure 1-7. Modelo teórico para la identificación de aeropuertos innovadores

Diferentes métodos de análisis se utilizan para esta investigación. La distribución Chi-cuadrado y el test de Shapiro-Wilk se utilizaron para comprobar si la adopción de sitios web por parte de los aeropuertos siguió una distribución normal. El análisis univariable y el análisis de varianza (ANOVA) se utilizaron para comprobar si el tamaño y la localización geográfica de los aeropuertos están relacionados con la adopción de los servicios móviles y la innovación del aeropuerto. El modelo del árbol de CART se utilizó para medir los efectos de la innovación del aeropuerto en la generación de ingresos comerciales. Finalmente, el modelo de la lógica borrosa conjuntamente con el método TOPSIS se utilizó para calcular el índice de calidad de servicio de aeropuerto (ASQI en sus siglas en inglés).

Uno de los objetivos del autor era dar clases en la universidad a la vez que realizaba la investigación a tiempo parcial. El autor impartió clases en Pekín (China) en un programa de MBA para la escuela de negocios ESEUNE durante tres semestres (2012-2013). Las clases impartidas sobre cultura de negocios en

China para estudiantes occidentales fueron creadas por el autor utilizando una metodología de clase invertida[4] en la que además se alternaba el aula con algunos de los sitios emblemáticos de China, como son la Gran Muralla o la Ciudad Prohibida. Además de las clases puso en marcha la primera edición del programa de prácticas en empresas. El verano de 2013 se traslada a vivir a Estambul (Turquía) y comienza a impartir clases en el programa de grado en gestión de transporte aéreo de la universidad de Ozyegin. Aquí también aplica el formato de clase invertida en sus cursos de *Airline Management* (Gestión de compañías aéreas) e International *Aviation Management* (Gestión de la aviación internacional). Junto a sus clases coordina el programa Erasmus y es miembro del grupo que coordina el programa de prácticas en empresas. Ha realizado varias iniciativas para intentar despertar el interés de los alumnos en la investigación científica con distintas actividades, siendo una de ellas el lanzamiento de la primera edición del seminario *Istanbul Hub Seminar* - sobre el sistema aeroportuario de Estambul (Martín-Domingo, Adiloglu, Erturk, & Peksatici, 2015).

La estrategia utilizada para tratar de establecer una colaboración de investigación, sobre los servicios de internet móvil de los aeropuertos, fue utilizar los contactos profesionales del autor, así como el grupo profesional de transporte aéreo en LinkedIn de la Universidad de Cranfield, con más de mil miembros. Una vez establecido el contacto, el autor compartía su blog (www.aeriport.com) para presentarse tanto el mismo como el tema de investigación. Los primeros contactos, fueron seguidos por reuniones cara a cara (cuando fue posible), llamadas telefónicas y correo electrónico.

Se seleccionó el uso de un blog y de vídeo, siguiendo el objetivo de utilizar nuevas herramientas que ayudaran tanto en el proceso de investigación como

[4] En la clase invertida (*flip the classroom*) los estudiantes ven videos de clases en línea, colaboran en discusiones en línea, o realizan actividades de investigación en casa y participan en el aula en discusiones y proyecto con la guía del profesor (Abeysekera & Dawson, 2015)

en la difusión de conocimiento. Para el blog se utilizó el software en código abierto de Wordpress, se adquirieron dos dominios de internet (aeriport.mobi y aeriport.com) y se contrataron servicios de hospedaje. El blog se encuentra activo desde 2011 y contiene la información sobre datos de contacto del autor, el tema de investigación de esta tesis y los artículos realizados. El autor pretendía desde el principio disponer de un repositorio digital personal en acceso abierto con toda la investigación realizada. La Figure 1-8 muestra el home de dicho blog.

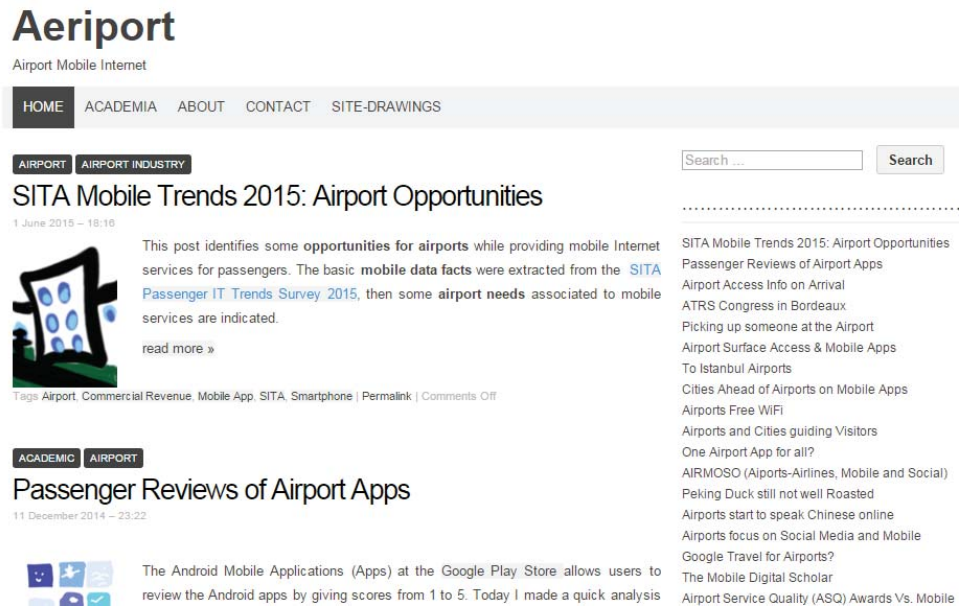

Figure 1-8. Pantalla del blog del autor aeriport.com

Para el uso de video se utilizó la plataforma gratuita de Youtube (Youtube.com) en la que el autor creo su propio canal y donde tiene los videos relacionados con esta investigación, así como los videos utilizados para la clase invertida mencionada con anterioridad. Para sus videos utilizados durante sus clases en China utilizo la plataforma de videos Youku (youku.com) ya que está restringido por el Gobierno chino el acceso a Youtube desde el territorio de la República Popular de China (con la excepción de Hong Kong y Macao). Para la generación de videos se utilizó primero la herramienta de Microsoft PowerPoint para crear las presentaciones y los videos fueron creados con la App para tabletas *ExplainEverything* (explaineverything.com).

1.3 Datos

Esta investigación utiliza principalmente métodos cuantitativos con una combinación de datos primarios y secundarios. Los datos secundarios utilizados en los tres primeros artículos (incluidos en el capítulo 3, capítulo 4 y capítulo 5) se componen de una base de datos de aeropuertos generada por la asociación internacional de aeropuertos – *Airport Council Internacional* (ACI[5]) el año 2010 y que contiene datos para los años 2009 y 2010. En esta se incluyen el número total de pasajeros, el número de pasajeros internacionales, la ubicación geográfica de cada aeropuerto y el grupo de aeropuerto basado en su tamaño y medido por número total de pasajeros anuales. Dicha base de datos se complementó con datos de ingresos comerciales para cada uno de los aeropuertos y extraída de diferentes fuentes. Entre ellas se incluyen los informes anuales de los aeropuertos, la *Federal Aviation Administration* (FAA)

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[5]"*Airport Council International (ACI) es la única asociación del sector de aeropuertos con representación global en todo el mundo. Fundada en 1991, ACI representa los intereses de los aeropuertos en su relación con los gobiernos y las organizaciones internacionales tales como la Organización de la Aviación Comercial Internacional (OACI), desarrolla normas, políticas y prácticas recomendadas para los aeropuertos, y proporciona información y oportunidades de formación para elevar los estándares en todo el mundo*". ACI tiene su sede en Montreal, Canadá, y está dividida en cinco regiones geográficas: África, Asia-Pacífico, América Latina-Caribe, América del Norte y Europa (ACI, 2015a).

El autor contacto a la sucursal europea de (ACI EUROPE) durante el comienzo de esta investigación. ACI EUROPE está comprometida, a través de la educación y formación, con la excelencia en la gestión aeroportuaria. Esta ofrece, a las instituciones académicas que tengan lazos con el transporte aéreo, la posibilidad de afiliarse y así disfrutar de ciertos beneficios. El autor, con el apoyo de su supervisor hizo todos los trámites para solicitar la afiliación de La Universidad de Las Palmas de Gran Canaria (ULPGC). En estos momentos la ULPGC es una de las veinte instituciones académicas europeas que forman parte de ACI EUROPE (ACI EUROPE, 2015)

en los Estados Unidos de America, OACI y ACI), así como las direcciones de los aeropuertos de sitios web de cada uno de los aeropuertos que fueron encontradas mediante el uso del buscador Google y Wikipedia (wikipedia.org) desde un laboratorio. Estas bases de datos se muestran de forma gráfica en la Figure 1-9.

Figure 1-9. Base de datos de aeropuertos ACI, ingresos comerciales y sitios web

Un Laboratorio básico, compuesto por una conexión a internet vía WiFi, un ordenador portátil y un dispositivo móvil (iPhone) se utilizó para recopilar datos primarios sobre los sitios web de aeropuertos, sitios web para móviles y Apps.

En el capítulo tres se partió de la base de datos con los 90 aeropuertos con mayor número de pasajeros en 2009 y correspondientes a tres de las regiones utilizadas por ACI: Europa, Norteamérica y Asia Pacífico. Se buscaron aquellos que tuvieran un sitio web para dispositivos móviles, y se evaluó el fácil acceso al sitio, la calidad de la información y la persuasión de su

información comercial. Para generar los datos, se utilizó una técnica de contado que según había concluido Law et al. (2010) en una revisión de setenta y cinco artículos era una práctica habitual en la evaluación de sitios webs. La Figure 1-10 muestra el proceso de forma gráfica.

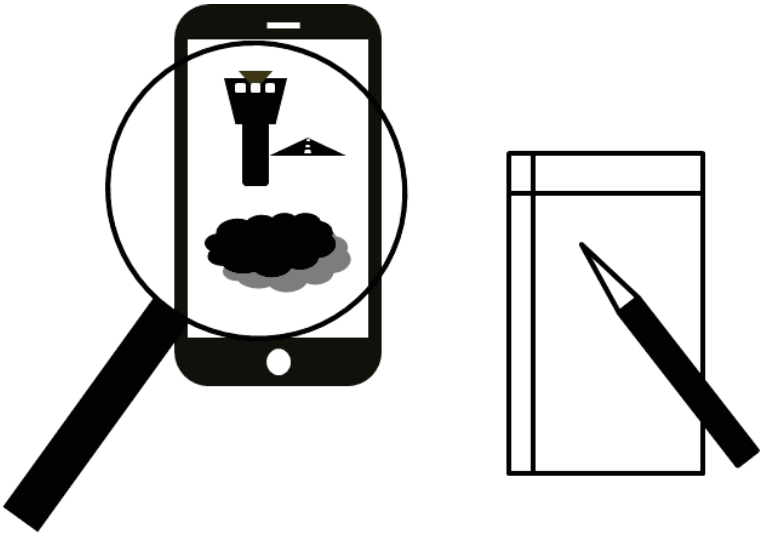

Figure 1-10. Evaluación de sitios web para dispositivos móviles de aeropuertos

En el capítulo cuatro, se aplica el modelo teórico basado en la teoría de la adopción de la innovación. Para las dos innovaciones analizadas (sitio web para PC y servicios para dispositivos móvil con internet). Se generaron datos tanto de la fecha de adopción de cada innovación, como del grado de implementación o sofisticación en el momento de hacer la evaluación para un total de 75 aeropuertos.

La fecha de adopción del sitio web se buscó a través de la fecha en la que cada aeropuerto había registrado su dominio web (e.g., el 23 de agosto de 1998 para el dominio bcia.com.cn del aeropuerto internacional de Pekín - Beijing Capital). Dichas fechas fueron sacadas de las autoridades encargadas de otorgar los dominios de internet - Una tabla completa de dichas fuentes puede encontrarse en la Table 1-1. Para buscar la fecha en la que los aeropuertos habían lanzado sus primeros servicios para dispositivos móviles con internet, se buscaron las notas de prensa donde los aeropuertos informaban de dicho

lanzamiento. La búsqueda se llevó a cabo a través de Google, donde se escribieron las palabras "sitio web móvil", "sitio móvil" y "aplicación móvil" seguidas de "site:" y la URL aeropuerto.

Table 1-1. Autoridades de registro de dominios de internet

URL	Domains	Notes
www.who.is	.com, .uk, .cn, .kr	
www.whois.ausregistry.com.au	.au	Register date - Not available
www.dns.be	.be	
www.nic.ch	.ch	Register date - Not available
www.denic.de	.de	Register date - Not available
www.nic.es	.es	
www.nic.gr	.gr	
www.domainregistry.ie	.ie	Register date - Not available
www.nic.it	.it	
whois.jprs.jp	.jp	
www.govcert.nl	.nl	Register date - Not available
www.dot.ph	.ph	Register date - Not available
www.nic.ru	.ru	

Source: Authors' own elaboration

El grado de implementación de los sitios web de los aeropuertos se midió evaluando tanto los sitios web, como los servicios de internet para dispositivos móviles. En ambos casos se tomaron factores de éxito utilizados en investigaciones científicas sobre evaluación de sitios web (Chiou et al., 2010; Y. A. Park & Gretzel, 2007). Para la evaluación de los sitios web para PC de los aeropuertos se tomó el factor de persuasión hacia la compra online evaluando los sitios web que disponían de servicios de reserva y compra online. Para la evaluación de los servicios de internet para dispositivos móviles se tomó el factor de fácil acceso a dichos servicios.

Los ingresos comerciales de los aeropuertos representaban en 2006 un 48,1% de los ingresos totales del aeropuerto y el análisis de los elementos más importantes permitía concluir que los servicios relacionados con las tiendas, aparcamiento, alquiler de coches, propiedad inmobiliaria y publicidad son los que tienen un mayor impacto (Graham, 2009). Por esta razón, la existencia o no de servicios de compras online, reserva de aparcamiento y alquiler de coches fueron evaluados para cada uno de los sitios web para PC de los

aeropuertos analizados. La tabla 4.4 en el capítulo 4 incluye todas las variables y pesos dados a cada una de ellas y la Figure 1-11 muestra gráficamente el proceso de toma de datos de forma manual.

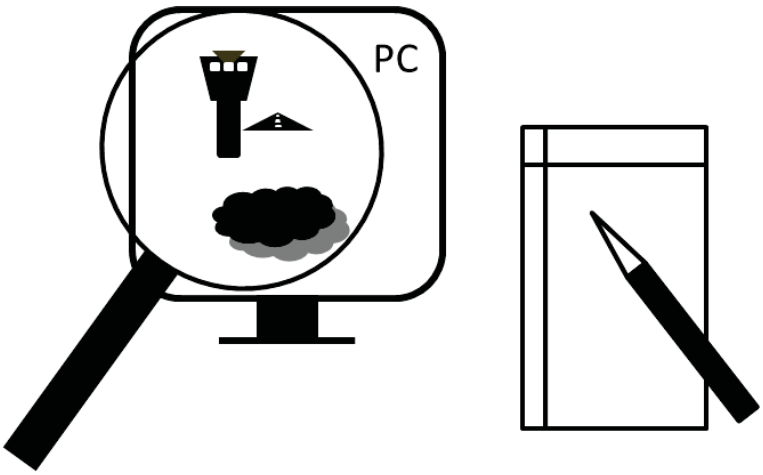

Figure 1-11. Grado de implementación de los sitios web para PC de aeropuertos

El grado de implementación de los servicios de internet para dispositivos móviles se midió analizando las plataformas (sitio web para dispositivo móvil y Apps disponibles de los sistemas operativos iOS – Phone – y Android) disponibles para cada uno de los aeropuertos analizados. Los sitios web para dispositivos móviles disponibles fueron también analizados por la facilidad que ofrecían para acceder al sitio web principal, así como para acceder al sitio web para PC desde el sitio para móvil. Esto es importante, porque los sitios web para dispositivos móviles son a menudo versiones reducidas de los sitios web para PC.

En el caso de las Apps, se hizo uso de un PC para averiguar su disponibilidad en el Apple Store para el caso del iPhone y en el Android Market (ahora denominado Google Play) para los dispositivos móviles con Android. Este proceso se representa gráficamente en la Figure 1-12 y permitió generar los datos del grado de implantación para los aeropuertos que suministraban algún tipo de servicio para dispositivos móviles.

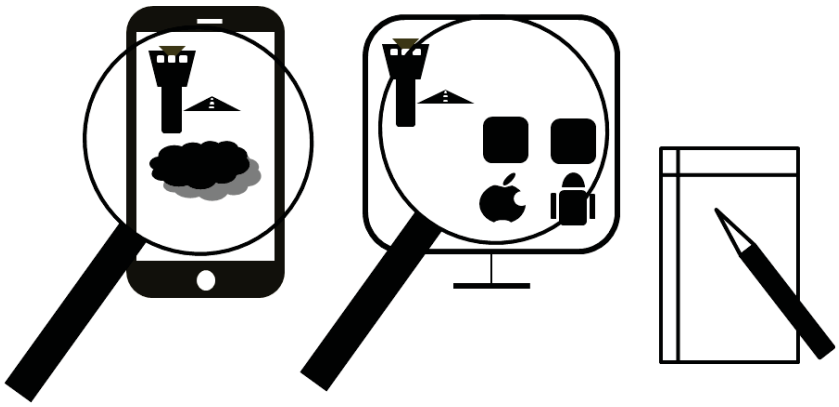

Figure 1-12. Búsqueda de los sitios web y Apps móviles de los aeropuertos

En el capítulo cinco, se partió de la misma base de datos de aeropuertos y se utilizó la misma metodología de búsqueda de los sitios web para dispositivos móviles y las Apps para los sistemas iOS (iPhone) y Android que en los capítulos tres y cuatro. En este caso, después de analizar la adopción de servicios de internet para dispositivos móviles alcanzada durante dicho estudio (2014), se pasó a evaluar los servicios móviles relacionados con el acceso por superficie al aeropuerto. De una base de datos inicial de 100 aeropuertos se tomaron los 31 aeropuertos europeos que tenían disponible una App iPhone y se evaluaron cada una de ellas, siguiendo el modelo adaptado para aeropuertos que Scolari y Fernández-Cavia (2014) sobre la evaluación de Apps de destinos turísticos. El proceso de toma de datos se representa gráficamente en la Figure 1-13.

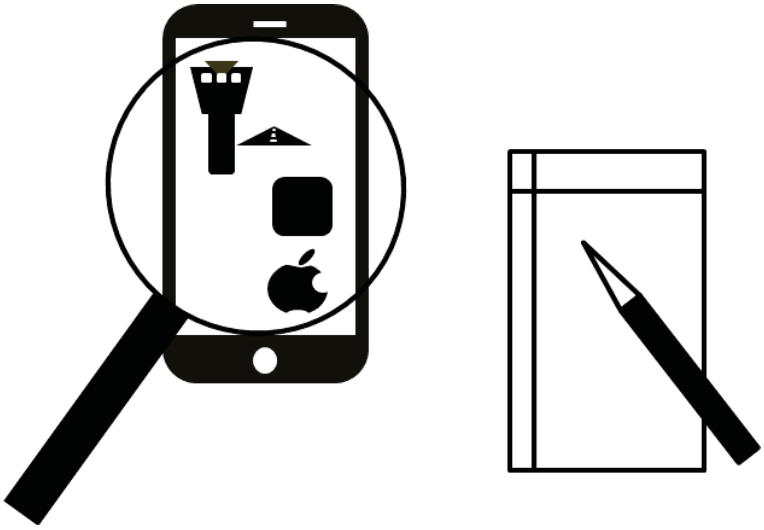

Figure 1-13. Evaluación de 31 App iPhone de aeropuertos

El capítulo seis utiliza una base de datos de la *International Air Transport Association* (IATA[6]) sobre calidad de servicio de los aeropuertos. La IATA llevo a cabo entre el año 1993 hasta el año 2001 una encuesta de calidad de servicio que llego a ser muy popular entre las compañías aéreas, los aeropuertos y los mismos medios de comunicación. Para esta investigación se ha tomado la base de datos correspondiente al séptimo año (1999) que se realizó la encuesta y que entonces se denominaba *lATA Global Airport Monitor*. Este estudio anual fue el precursor del que todavía existe denominado Airport Service Quality (ASQ) y que lleva a cabo ACI (ACI - ASQ, 2015).

[6] La organización internacional IATA (International Aviation Transport Association en sus siglas en inglés) es la mayor asociación de compañías aéreas del mundo. En Septiembre del año 2015 representaba a 260 compañías aéreas que a su vez transportaban el 83 por ciento del tráfico mundial. Entre sus objetivos están los de apoyar muchas de las áreas de la aviación comercial y ayudar a formular estándares de la industria que son críticos para la aviación (IATA, 2015).

Dicha base de datos corresponde al año 1999[7] y proporciona indicadores de calidad de servicio (ASQ) para 57 de los principales aeropuertos internacionales de Europa, América del Norte, Oriente Medio y Asía Pacífico. Los datos incluyen las percepciones de más de 42,517 pasajeros internacionales en 24 categorías de servicios y fueron generados a partir de dos encuestas: (1) Encuesta de pasajeros internacionales llevada a cabo por IATA entre los pasajeros de sus aerolíneas miembros donde miden el rendimiento de cada aerolínea para así compararlo con el de otras aerolíneas; en dicha encuesta también encuestaban a los pasajeros sobre los servicios en los aeropuertos de salida y llegada. (2) los aeropuertos también podían participar en el estudio mediante la distribución de encuestas separadas basadas en los servicios del aeropuerto. La Figure 1-14 muestra la base de datos de forma gráfica.

Figure 1-14. Base de datos de IATA sobre ASQ

[7] El autor es consciente que se trata de una base de datos muy antigua. En este sentido el autor hizo todo lo posible por buscar datos más recientes y es posible que los consiga de un aeropuerto con el que está en conversaciones de colaboración, pero dichos datos no será posible utilizarles para esta tesis. Sin embargo el objeto de esta investigación está más relacionado con el método de cálculo del índice sintético de ASQ (calidad de servicio en sus siglas en inglés – *Airport Service Quailty*)

Una vez explicadas la generación de los datos primarios de esta investigación como los datos secundarios utilizados, la siguiente sección explica cómo esta tesis se organiza, introduciendo cada uno de sus capítulos.

1.4 Estructura de la tesis y contenido

Dos cosas que afectan la estructura de esta tesis son: (1) Su núcleo principal está compuesto por cuatro artículos de investigación separados; y (2) está escrita en inglés e incluye un resumen con la introducción y conclusiones de la tesis en español. Tomando estas dos peculiaridades en cuenta, la tesis se organiza de la siguiente manera.

Este primer capítulo (capítulo 1) en español, incluye con un resumen general de la investigación y es seguido por el resto de la tesis en inglés. El segundo capítulo incluye la introducción de la tesis. Cada uno de los siguientes cuatro capítulos siguientes (capítulo 3, capítulo 4, capítulo 5 y capítulo 6) incluyen cada uno de los cuatro artículos incluidos. El último capítulo (capítulo 7) incluye las conclusiones generales, limitaciones de la investigación, aportación al estado del arte y líneas de investigación futuras. A continuación se presenta el contenido resumen de cada uno de los cuatro artículos.

El capítulo 3 incluye el primer artículo que se realizó durante las primeras fases de esta investigación y poco después de que los aeropuertos comenzasen a adoptar estos nuevos servicios móviles de internet para dispositivos móviles. Así que puede considerarse como el primer contacto del autor con el tema investigado. El artículo incluido se titula *Airport Mobile website Evaluation: Terminal Navigation & Commercial Revenue* (Evaluación de sitios web para móviles de aeropuertos: Navegación e Ingresos Comerciales) y una representación gráfica resumen puede encontrarse en la Figure 1-16. Este artículo explora la adopción de sitios web para dispositivos móviles por parte de los aeropuertos (ver el ejemplo del aeropuerto de Dallas / Fort Worth en la Figure 1-15) y analiza si estos nuevos servicios contribuyen a superar el doble reto de guiar a los pasajeros por todo el aeropuerto, a la vez que se incrementan los ingresos comerciales.

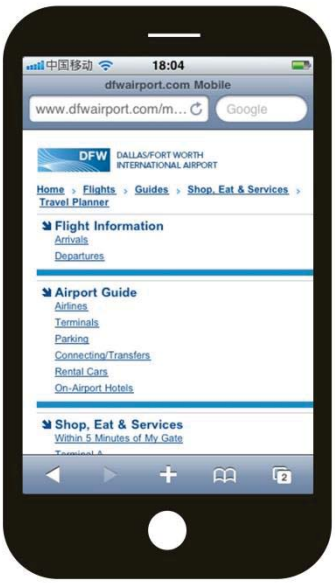

Figure 1-15. Sitio web para móviles del aeropuerto de Dallas en 2011.

Dicho artículo estudia los 100 aeropuertos más grandes del mundo en término de número de pasajeros, primero identifica los aeropuertos que ofrecen sitios web para móviles a sus pasajeros. Después, utilizando métodos de evaluación de sitios web, se evalúan tres atributos de los sitios web para dispositivos móviles de 22 aeropuertos: 1) El fácil acceso al sitio web; 2) la calidad de la información; y 3) la información comercial. Los resultados muestran que los aeropuertos europeos y norteamericanos más grandes son más propensos a ofrecer servicios de internet para dispositivos móviles; Los aeropuertos europeos proporcionan una mayor calidad de información para orientar a sus pasajeros; y estos sitios web para dispositivos móviles aún no se utilizan activamente para informar, a la vez que promueven tanto las ventas online como en las tiendas del aeropuerto.

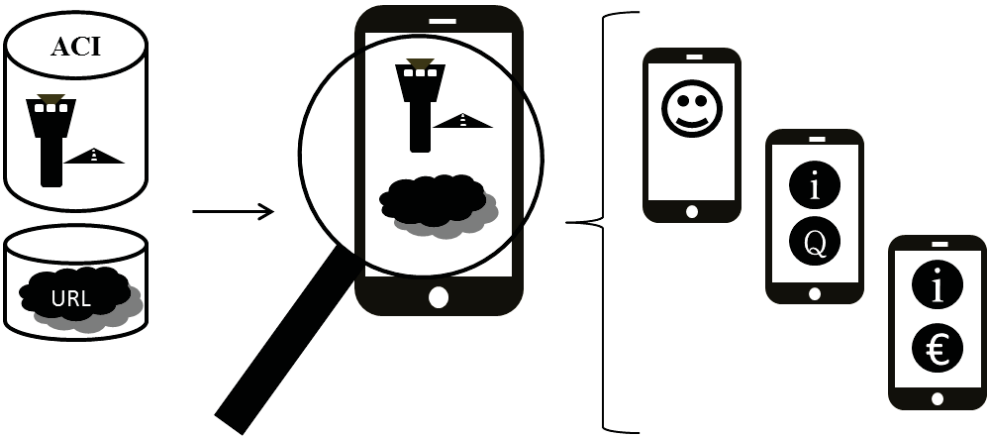

Figure 1-16. Evaluación de sitios web para móviles de aeropuertos: Navegación e Ingresos Comerciales

Una vez observado que los aeropuertos habían comenzado a adoptar estos nuevos servicios móviles para dispositivos móviles (aproximadamente un cuarto de ellos), y que la adopción de dichos servicios de internet para dispositivos móviles podía considerarse como una innovación, ateniéndose a la siguiente definición de innovación tecnológica: "la conversión del conocimiento tecnológico en nuevos servicios" (Orfila-Sintes, Crespo-Cladera, & Martinez-Ros, 2005)[8]. El autor decide estudiar entonces si esos aeropuertos que habían comenzado a adoptar primero dichos servicios podían considerarse aeropuertos realmente innovadores. El capítulo 4 incluye esta investigación en un artículo que se titula *Airport Mobile Internet as an Indication of Innovation* (Sitios web para móviles y Apps de los aeropuertos como indicador de

[8] La definición completa data por Orfila-Sintes et al. (2005) sobre innovación tecnológica es: "*the conversion of technological knowledge into new products, new services or new processes introduced in the market, as well as the significant technological changes in products, services and process*". Esta podría ser traducida como "la conversión del conocimiento tecnológico en nuevos productos, nuevos servicios o nuevos procesos introducidos en el mercado, así como cambios tecnológicos significativos en los productos, servicios y procesos.

innovación). Dicho artículo estudia la adopción de los servicios de internet ofrecidos a pasajeros con dispositivos móviles por parte de los aeropuertos.

Definiendo primero un modelo teórico, que se apoya en la teoría sobre la adopción de la innovación, después pasa a comprobar si a los aeropuertos que primero adoptan estos servicios se les puede considerar realmente innovadores. Para ello, analiza setenta y cinco aeropuertos internacionales, localizados en cuatro continentes y de tamaños mediano, grande y muy grande. Esta investigación complementa el análisis incluyendo una segunda innovación, el sitio web para para PC. Para ambas innovaciones se analizan dos atributos, el momento en el que han adoptado dichas innovaciones así como el grado de implementación o sofisticación de cada una de ellas. Se concluye que hay cuatro aeropuertos realmente innovadores: Londres Heathrow, Londres Stansted, Amsterdam Schiphol y Copenhague. La capacidad innovadora de los aeropuertos no parece estar relacionada con el tamaño de los aeropuertos, pero si lo está con la ubicación geográfica donde se encuentran. Además, el ingreso comercial por pasajeros se ve afectado por el momento de la adopción de la innovación. La Figure 1-17 muestra de forma gráfica el resumen del artículo, que en el momento de escribir esta sección se encuentra en fase de revisión en la revista *Journal of Air Transport Management (JATM)*[9].

[9] El JATM se puede encontrar en la siguiente URL: http://www.journals.elsevier.com/journal-of-air-transport-management

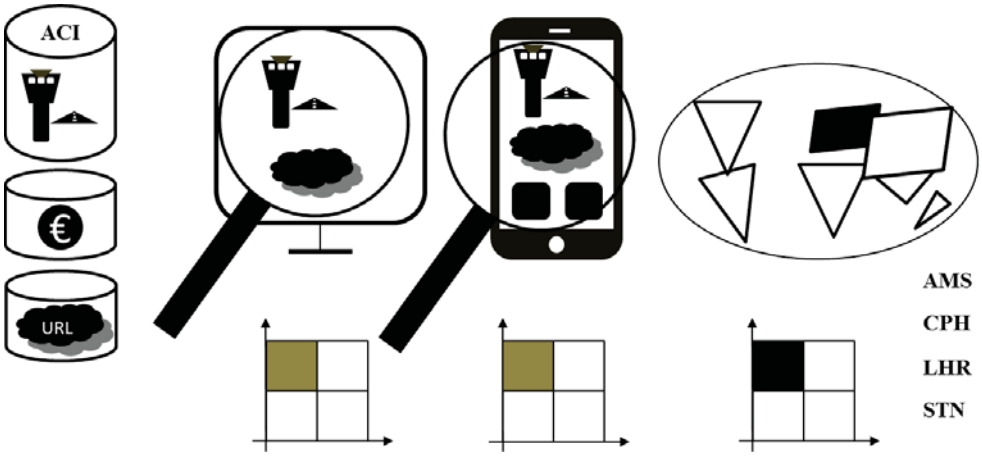

Figure 1-17. Sitios web para móviles y Apps de los aeropuertos como indicador de innovación

Haciendo un pequeño resumen hasta este punto veíamos que en el capítulo 3 se evaluaban los sitios móviles para dispositivos móviles de los aeropuertos, en el capítulo 4, a la evaluación sobre sitios web para dispositivos móviles, se le sumaba la evaluación sobre las aplicaciones (Apps) disponibles por parte de los aeropuertos de los sistemas operativos iOS y Android. Por otro lado, uno de los objetivos de esta investigación era la de analizar cómo estos nuevos servicios móviles contribuían a afrontar algunos de los retos a los que se enfrentaban los aeropuertos. Entre ellos, estaba el aumento del tráfico en los alrededores del aeropuerto – causante de retrasos y contaminación –, junto con la necesidad de desarrollar los ingresos comerciales. En el capítulo 5 se evalúan Apps de los aeropuertos teniendo en cuenta dicho doble reto a través del artículo titulado *Airport Surface Access and Mobile Apps* (Acceso por Superficie al Aeropuerto y las Apps Móviles).

El acceso por superficie a los aeropuertos presenta dos retos importantes, que a su vez son opuestos: (1) El automóvil, siendo el principal modo de transporte, contribuye al aumento del nivel de congestión y de contaminación de las ciudades; y (2) al mismo tiempo, los ingresos de parking son una importante fuente de ingresos de los aeropuertos comerciales, creando un dilema a los gestores de aeropuertos cuando se enfrentan al problema. Por otro lado, teniendo en cuenta la tendencia creciente de los pasajeros aéreos que viajan con

smartphone (78% en 2013), este trabajo estudia la adopción de los servicios para las Apps móviles por parte de los aeropuertos y analiza si la información y las funciones provistas en dichas Apps pueden ayudar a buscarle una solución a los problemas planteados.

En esta investigación se toman 31 Apps para iPhone de algunos de los mayores aeropuertos europeos y se evalúan desde un laboratorio, utilizando como base el modelo de evaluación de destinos y Apps móviles (Scolari & Fernández-Cavia, 2014), pero adaptado para la evaluación del acceso por superficie en las Apps de los aeropuertos. En los resultados obtenidos, se observa que las Apps evaluadas ofrecen una funcionalidad muy limitada para ayudar a los pasajeros a planificar y reservar sus viajes a / desde los aeropuertos en transporte público, y dan una prioridad clara a la información y servicios de parking. El resumen de este artículo se representa gráficamente en la Figure 1-18 y ha sido publicado[10] en la revista *Journal of Airline and Airport Management.*

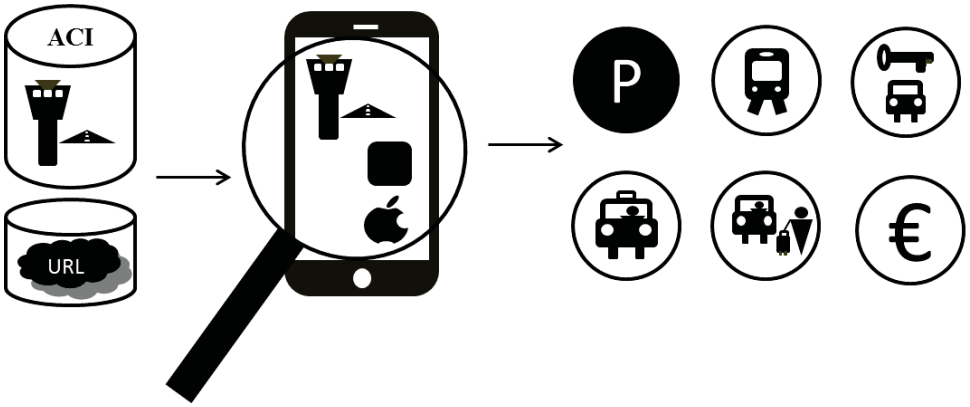

Figure 1-18. Acceso por superficie al aeropuerto y las Apps móviles

[10] La copia del artículo publicado se puede acceder a través del siguiente URL: http://dx.doi.org/10.3926/jairm.38

En los tres capítulos anteriores se ha estudiado qué aeropuertos habían adoptado estos nuevos servicios de internet para dispositivos móviles en tres momentos en el tiempo (2011, 2013 y 2014), se han identificado los aeropuertos innovadores teniendo en cuenta la adopción de estos servicios de internet para dispositivos móviles y se ha evaluado cómo dichos nuevos servicios ayudan a los aeropuertos a superar ciertos retos (i.e., guiar a los pasajeros, desarrollar los ingresos comerciales y aminorar la congestión de tráfico en los alrededores del aeropuerto). Un cuarto reto identificado en la motivación de esta investigación es la calidad de servicio de los aeropuertos (ASQ en sus siglas en inglés).

El objetivo de esta investigación era la de conectar la ASQ con los servicios de internet para dispositivos móviles. El plan era utilizar estos servicios de internet móvil para facilitar el proceso de toma de datos por parte de los aeropuertos de la ASQ. Por ejemplo, que los pasajeros pudieran acceder a un cuestionario desde sus dispositivos móviles para agilizar el proceso de toma y precisión de los datos. Dicho plan no se pudo llevar a cabo porque era necesaria una colaboración con un aeropuerto para implementarlo, y ésta no ha sido posible establecerla durante el periodo de esta investigación.

Finalmente, el autor decidió hacer una investigación sobre ASQ, independiente del uso de los servicios de internet para dispositivos móviles, que pueda contribuir al área de conocimiento de ASQ. Con ello, el autor también ha pretendido profundizar su conocimiento en el área de ASQ aprovechando que su supervisor ha realizado diferentes análisis de calidad de servicio en distintos contextos, esperando poder hacer uso de dicho conocimiento sobre ASQ, junto con el de los servicios de internet para dispositivos móviles muy pronto.

Así en el capítulo 6 se incluye un artículo titulado *Airport Service Quality using Fuzzy numbers and TOPSIS* (Calidad de servicio del aeropuerto usando números fuzzy y TOPSIS). Este artículo presenta una aproximación lógica difusa con el fin de resolver un problema multidimensional que evalúa la calidad de los servicios del aeropuerto. La teoría de conjuntos difusos se utiliza aplicando números borrosos triangulares (TFN en sus siglas en inglés) como método para superar algunos problemas de lenguaje, es decir, la ambigüedad de los conceptos que se asocian con juicios subjetivos en la medición de la calidad del servicio con términos lingüísticos. Basado en el concepto del grado

de optimización, a través del método TOPSIS, un índice de ASQ sintético se desarrolla para una muestra de cincuenta y siete aeropuertos tipo hub, utilizando los datos de veinticuatro atributos diferentes. Los coeficientes de elasticidad SQ se calculan para un grupo con los mejores y los peores aeropuertos en términos de SQ y para todos los atributos. Nuestros resultados permiten a los gestores de los aeropuertos identificar las diferentes dimensiones que pueden ser objeto de mejora y que podría producir las mayores ganancias del índice ASQ.

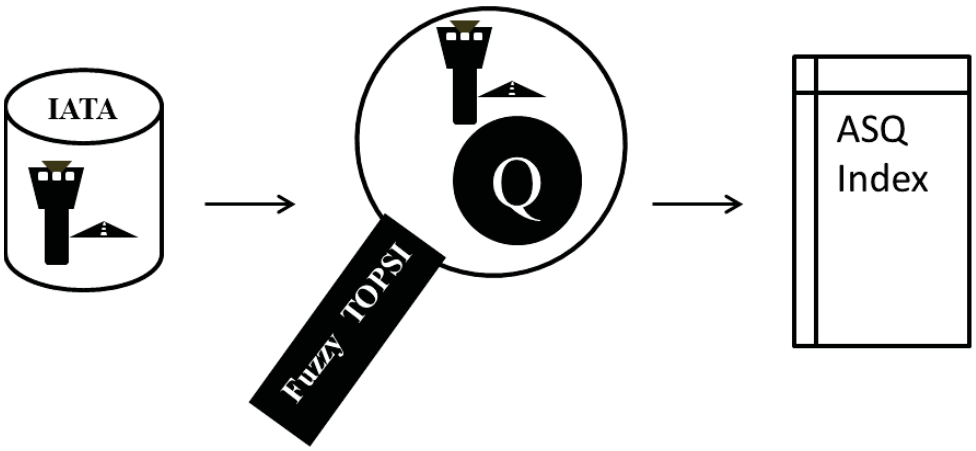

Figure 1-19. Calidad de servicio del aeropuerto usando números fuzzy y TOPSIS

Finalmente, el Capítulo 7 incluye las conclusiones de esta investigación en inglés que se desarrollan en español a continuación.

1.5 Conclusiones

Esta sección comienza con unas conclusiones generales de la investigación, y continúa con las conclusiones extraídas de cada uno de los cuatro artículos: La sección 1.5.2 incluye las conclusiones de artículo *Airport Mobile website Evaluation: Terminal Navigation & Commercial Revenue* (Evaluación de sitios web para móviles de aeropuertos: Navegación e Ingresos Comerciales); la sección 1.5.3, conclusiones del artículo *Airport Mobile Internet as an Indication of Innovation* (Sitios web para móviles y Apps de los aeropuertos como indicador de innovación); la sección 1.5.4, conclusiones del artículo *Airport Surface Access and Mobile Apps* (Acceso por Superficie al Aeropuerto y las Apps Móviles); y finalmente la sección 1.5.5, incluye las conclusiones del artículo *Airport Service Quality using Fuzzy numbers and TOPSIS* (Calidad de servicio del aeropuerto usando números fuzzy y TOPSIS).

Las conclusiones generales ofrecen un resumen con una visión global de la investigación, a la vez que añade las conclusiones a otros dos objetivos definidos para esta investigación: Establecer vínculos entre academia y la industria y el uso de herramientas tecnológicas durante la investigación.

1.5.1 Conclusiones generales

El porcentaje de ambos, los pasajeros que viajan con dispositivos móviles con internet y los aeropuertos que prestan el servicio de internet móvil a los pasajeros, sigue aumentando a buen ritmo (26% en 2011 y 69% en 2014). Esta conclusión se obtiene teniendo en cuenta la evolución observada en los diferentes horizontes temporales (2011, 2013 y 2014) en los que dichos datos fueron obtenidos. Por tanto, es de esperar que en un futuro próximo, prácticamente todos los pasajeros viajen con un dispositivo móvil con internet y todos los aeropuertos proporcionen servicios de internet para dar servicio a dichos pasajeros.

A la hora de ofrecer dichos servicios de internet móvil para dispositivos móviles, por parte de los aeropuertos, el sitio web para dispositivos móviles era claramente el servicio más habitual ofrecido en la primera fase de esta investigación (2011). Sin embargo, durante los tres últimos años, a la vez que

se han consolidado los sistemas operativos móviles iOS para el dispositivo iPhone y el sistema Android, un número creciente de aeropuertos ha comenzado a ofrecer también aplicaciones (Apps) para estos dos sistemas operativos. En estos momentos, los aeropuertos que prestan servicios móviles de internet, tienden a ofrecer ambos servicios (sitios web para dispositivos móviles con internet y Apps para los sistemas operativos iOS y Android).

Cuando analizamos los aeropuertos que han tenido una adopción temprana de estos servicios de internet para dispositivos móviles, vemos que no existe una relación clara entre dicha adopción temprana y su tamaño. Sin embargo existe una correlación entre dicha adopción temprana y dos variables de interés analizadas, los ingresos comerciales unitarios que generan y la ubicación geográfica donde se encuentran situados. Entre los aeropuertos norteamericanos y europeos existe una mayor probabilidad de encontrar uno que ofrezca servicios de internet móvil y cuatro aeropuertos europeos fueron considerados realmente innovadores (Londres Heathrow, Londres Stansted, Amsterdam Schiphol y Copenhague)[11], siendo la adopción temprana una condición para ello.

Cuando se ha analizado en esta investigación la información y los servicios concretos que proporcionan los aeropuertos, a través de los servicios de internet para dispositivos móviles, se ha observado que dicha información y

[11] Los servicios de internet para dispositivos móviles de cada uno los cuatro aeropuertos identificados como realmente innovadores pueden encontrarse en las siguientes URLs:
Londres Heathrow:
http://www.heathrow.com/more/mobile-apps
Londres Stansted:
http://www.stanstedairport.com/help-and-advice/stay-up-to-date/mobile-app/
Amsterdam Schiphol
http://www.schiphol.nl/Travellers/FlightInformation/SchipholAppAndMobilewebsite.htm
Copenhague:
https://www.cph.dk/en/flight-info/app/

servicios no distan demasiado de los que los pasajeros encuentran al pasar por la terminal del aeropuerto. Esto es positivo porque este nuevo servicio complementa los medios tradicionales. Por ejemplo, uno de los servicios de internet móvil más comunes ofrecidos es toda la información que un pasajero necesita para embarcar en un vuelo desde que llega al aeropuerto o incluso desde que sale de su casa u oficina. Esto incluye los medios de transporte disponibles, la terminal desde donde vuela, el mostrador de facturación, la puerta de embarque, etc. Los aeropuertos, sin embargo, aún no están beneficiándose, o lo hacen de forma muy tímida, de las posibilidades "inteligentes" que esta tecnología ofrece.

En esa dirección “inteligente”, los aeropuertos además de ofrecer una información útil y completa que permita al pasajero llegar a la puerta de embarque (en vuelos de salida y en conexión) o al destino final (en vuelos de llegada), pueden ofrecer servicios de valor añadido al pasajero con una oferta personalizada y acorde a las áreas del aeropuerto por las que el pasajero pasa hasta su destino final. Una oferta concreta, relacionada con el acceso el acceso por superficie al aeropuerto y analizada en el capítulo 5, podría ser la de dirigir al pasajero al uso del transporte público, al mismo tiempo que generar ingresos comerciales a través de la venta de billetes en dichas Apps.

El uso actual de la tecnología móvil tanto por parte de los aeropuertos como de los pasajeros aéreos permite nuevas formas de interacción entre ambos. La Figure 1-20 muestra un ejemplo de dicha interacción entre el aeropuerto de Londres Heathrow, y sus pasajeros, utilizando la red social Twitter.

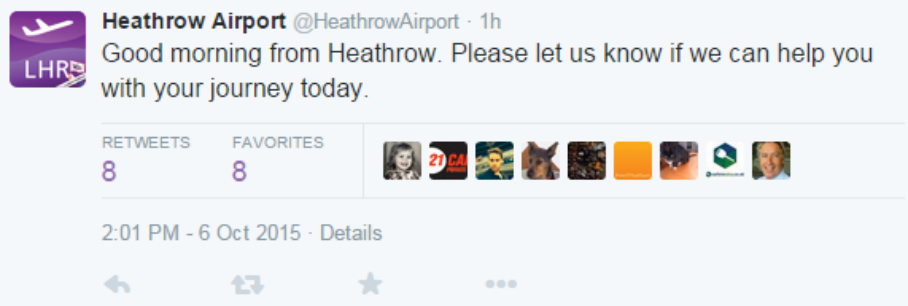

Figure 1-20. Mensaje en Twitter del aeropuerto de Londres Heathrow[12]

Estas nuevas interacciones por si mismas pueden contribuir a aumentar la calidad de servicio del aeropuerto (ASQ en sus siglas en inglés). Además, dichas conversaciones entre el aeropuerto y los pasajeros generan una buena cantidad de datos que incluyen puntos de vista y opiniones sobre los diferentes servicios del aeropuerto por parte de los pasajeros. El análisis de dichos datos podría complementar la investigación sobre ASQ y contribuirán muy positivamente a paliar la gran dificultad de acceder a este tipo de datos.

La experiencia personal del autor al tratar de establecer relaciones entre la investigación académica y la industria aeroportuaria ha demostrado ser muy difícil. Después de establecer, a lo largo de diferentes momentos de esta investigación, contacto con hasta cinco aeropuertos (i.e.: Manchester - MAN, Frankfurt - FRA, Beijing Capital - PEK, Estambul Sabiha - SAW y Estambul Ataturk - IST), interesados en el tema de la presente investigación sobre el uso de los servicios móviles de internet, sólo fue posible implementar algún tipo de cooperación con uno de ellos, y casi al final de esta investigación. Por lo tanto, los frutos potenciales de dicha colaboración no pueden ser incluidos en esta investigación. En el momento de terminar la redacción de este documento, se está a la espera de la firma de un acuerdo de confidencialidad por parte de uno

[12] La URL de la red social Twitter del aeropuerto London Heathrow: https://twitter.com/HeathrowAirport

de los aeropuertos. Este era uno de los requisitos por parte de la compañía aeroportuaria para iniciar la colaboración.

Teniendo en cuenta las mencionadas experiencias, se recomienda que cualquier colaboración no se lleve a cabo solamente para un sólo proyecto. Una hipotética colaboración podría incluir acuerdos a distintos niveles, tales como programas de prácticas; el aprendizaje basado en problemas –PBL: "*Problem Based Learning*" - en sus siglas en inglés - (Prince & Felder, 2006), en los cuales la industria propone problemas que son resueltos por estudiantes con el apoyo de sus profesores; y programas de investigación que podrían incluir un estudiante de doctorado que realiza su tesis de investigación sobre un tema relevante para la industria.

Durante el tiempo que duró esta investigación, el autor coordinó dos programas de prácticas en empresas: Uno en Beijing durante 2013 con estudiantes de MBA y la otra en Estambul durante 2015 con Estudiantes de grado en Gestión del Transporte Aéreo. Los resultados en ambos casos fueron muy satisfactorios tanto para la institución académica como para las empresas. Por lo tanto, los programas de prácticas en empresas parecen ser también una buena forma de colaboración entre el mundo académico y la industria.

Para los proyectos de investigación a nivel de postgrado entre la universidad y la industria, se recomienda siempre que sea posible buscar un interlocutor en la industria que tenga conocimientos sobre el campo de la investigación, al mismo tiempo que ocupe un puesto con cierto grado de toma de decisiones dentro de la organización. Este doble criterio lo cumple el interlocutor encontrado en el aeropuerto con el que nos encontramos en proceso de firmar un acuerdo de confidencialidad. Para los otros cuatro casos, en dos de ellos el interlocutor no cumplía ninguno de los dos criterios y en los otros dos, sólo estaba bien familiarizado con la investigación académica, pero no ocupaba un cargo con poder de decisión.

El uso de blog y video durante esta investigación ha ayudado al autor a mejorar sus habilidades de comunicación, mientras realizaba esta investigación y daba sus clases. Por ejemplo, durante la conferencia sobre el transporte aéreo ATRS que se celebró en Burdeos en julio de 2014, le fue posible aplicar el método de "invertir la conferencia[13]", colocando una presentación en video[14] en su blog que el público pudo ver con antelación, con el fin de dedicar el tiempo en la conferencia a discutir el artículo. El artículo presentado en dicha conferencia, introdujo algunos cambios sugeridos durante la discusión y ahora se puede encontrar en el capítulo 5).

Esta experiencia positiva motivó al autor a invertir sus clases en gestión de la aviación internacional y gestión de las compañías aérea en la Universidad Ozyegin de Estambul a partir de febrero de 2015. La evaluación dada por los estudiantes al final del semestre fue positiva y continua utilizando esta nueva forma de enseñanza.

Los conocimientos adquiridos durante su investigación sobre cómo crear y mantener un blog le han servido al autor, no sólo para su investigación, sino también durante sus clases. En estos momentos cada uno de sus estudiantes tiene un blog personal donde incluye todos los trabajos requeridos durante su sistema de evaluación continua.

Como continuación a las conclusiones generales de la investigación, a continuación se extraen las conclusiones de cada uno de cuatro artículos.

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[13] El término "invertir la conferencia" se ha tomado prestado del término "invertir la clase (*flip the classroom*)". En una clase invertida, los estudiantes ven videos de clases en línea, colaboran en discusiones en línea, o realizan actividades de investigación en casa y participan en el aula en discusiones y proyectos con la guía del profesor (Abeysekera & Dawson, 2015)

[14] Dentro del siguiente URL se puede acceder al link del video utilizado para la presentación del artículo. http://aeriport.mobi/atrs

1.5.2 Conclusiones Capítulo 3

El capítulo 3 incluye el artículo titulado *Airport Mobile website Evaluation: Terminal Navigation & Commercial Revenue* (Evaluación de sitios web para móviles de aeropuertos: Navegación e Ingresos Comerciales). Aquí se extraen sus conclusiones.

Los nuevos servicios aeroportuarios, a través de sitios web para móviles, es una buena herramienta que los operadores de aeropuertos tienen ahora a su alcance. Por un lado ayudan a los pasajeros a orientarse y buscar información en las terminales de los aeropuertos, y por otro pueden ayudar a los mismos aeropuertos a generar más ingresos comerciales. La evaluación de sitios web para móviles de aeropuertos realizada en esta investigación (realizada en 2011) muestra una etapa temprana en la prestación de este servicio por parte de los aeropuertos.

Un 26 por ciento de los aeropuertos más grandes de Norte América, Europa y Asia Pacífico tienen este servicio de sitio web para móviles disponible. Si se tiene en cuenta la ubicación geográfica, existe una mayor probabilidad de encontrar este servicio entre los aeropuertos europeos y norteamericanos. Si se compara con otros sectores, el nivel de adopción por parte de los aeropuertos está por debajo de los niveles alcanzados en otros sectores del turismo (por ejemplo, las líneas aéreas o los hoteles). Por lo tanto, se espera que la adopción aumente en un futuro próximo.

El acceso por parte de los pasajeros al contenido de los sitios web para móviles que ofrecen los aeropuertos es fácil, una vez que se dispone de la dirección del sitio web. La gran mayoría de aeropuertos dirige al pasajero automáticamente al sitio web adaptado para móviles. Sin embargo, se recomienda una opción fácil para acceder al contenido de la página web del aeropuerto, que no se encuentre disponible en el sitio web para móviles.

La calidad de la información de salida disponible en los sitios web para móviles es mayor en la información relacionada con las compañías aéreas (e.g.: nombre de la aerolínea o número de vuelo) que la información relacionada con el aeropuerto (e.g.: número de terminal, mapas o número de puerta). El tamaño de los aeropuertos no parece explicar las diferencias en calidad. Sin embargo,

si su ubicación, siendo los aeropuertos europeos los que proporcionan una mayor calidad de información.

Los aeropuertos no explotan bien las posibilidades que ofrece este nuevo servicio para estimular los ingresos comerciales. La información comercial estaba presente en la mitad de los sitios web para móviles evaluados de forma estática y sólo un 9 por ciento de los aeropuertos muestra la información comercial de forma dinámica, junto con la información de salida de los vuelos.

1.5.3 Conclusiones Capítulo 4

El capítulo 4 incluye el artículo que lleva como título *Airport Mobile Internet as an Indication of Innovation* (Sitios web para móviles y Apps de los aeropuertos como indicador de innovación). A continuación se extraen sus conclusiones.

El análisis sobre el momento de adopción de los servicios de Internet para móvil de los aeropuertos se encuentra todavía en su infancia y el grado de penetración de esta innovación en el momento de hacer el estudio es todavía limitada. Sin embargo, los aeropuertos están aumentando sus presupuestos en tecnologías de la información y las telecomunicaciones, mientras aparecen otras nuevas como la geolocalización, NFC (Near Field Communicatón), beacons y otros. Así que este nuevo campo de investigación merece ser estudiado y analizado, ya que muy pronto las App móviles se van a convertir en un servicio básico. Los aeropuertos se encuentran todavía en las primeras etapas de aprovechar todo el potencial de estos servicios para dispositivos móviles. Entonces, si trasladamos la conclusión de Gillen y Lall (2002), sobre las páginas webs: "la primera iniciativa que los aeropuertos puede tener, es mejorar sus sitios web". Ahora podríamos decir lo mismo de sus servicios de internet para dispositivos móviles.

En esta investigación, primero se define un modelo teórico, basado en la teoría de la innovación, que nos ayuda a definir cuando un aeropuerto puede considerarse verdaderamente innovador. En nuestro caso está basado en dos innovaciones complementarias, la del sitio web para PC y la de los servicios de internet para dispositivos móviles. Estas dos innovaciones se analizan a través

de dos dimensiones: el momento en el tiempo que se adoptan y el grado de implementación o sofisticación.

La base de datos fue compilada en un laboratorio e incluye tanto la fecha en la que se lanzó la innovación, como su grado de implementación medido a través de ciertas características, tanto el sitio web para PC como de los servicios de internet para dispositivos móviles. Siguiendo los supuestos incluidos en el experimento del laboratorio respecto a la selección de los pesos adecuados de una lista original con los 145 aeropuertos más grandes del mundo, en número de pasajeros, se toman finalmente 75 aeropuertos de tres tamaños diferentes y cuatro regiones del mundo. La razón de descartar aeropuertos fue la falta de datos de ingresos comerciales y de la fecha de adopción de alguna de las dos innovaciones estudiadas.

Los aeropuertos realmente innovadores son aquellos que se localizan en el cuadrante innovador (adopción temprana y grado de implementación alto) para las dos innovaciones analizadas (sitio web para PC y servicios de internet para dispositivos móviles). Se identifican cuatro aeropuertos realmente innovadores: Amsterdam Schiphol (AMS), Copenhague (CPH), London Heathrow (LHR) y London Stansted (STN).

Analizando el patrón de la distribución de la fecha en la que la innovación de la página web para PC se adopta, se demuestra que dicho patrón no responde a una distribución normal. Sin embargo, excluyendo de la base de datos algunas de las observaciones más tardías, se observa que entonces si responde a una distribución normal y por tanto se puede considerar que cuatro de los 75 aeropuertos pueden considerarse como “rezagados-intensos”.

Se analizan tres características de los aeropuertos: Tamaño, localización geográfica e ingresos comerciales por pasajero. Las dos primeras características se analizan aplicando un modelo basado en modelos convencionales de análisis de varianza, y se concluye que el tamaño del aeropuerto no está relacionado con la innovación, pero si la localización geográfica. Los aeropuertos europeos aparecen como más innovadores que el resto. La tercera característica, el ingreso comercial por pasajeros está afectado por el momento en el que se adopta la innovación.

1.5.4 Conclusiones Capítulo 5

En esta sección se extraen las conclusiones del capítulo 5 que incluye el artículo titulado *Airport Surface Access and Mobile Apps* (Acceso por Superficie al Aeropuerto y las Apps Móviles).

La generalización en el uso de los dispositivos móviles con acceso a Internet por parte de los pasajeros y el suministro de Apps móviles por parte de los aeropuertos es reciente.

La información del acceso al aeropuerto por superficie (e.g. desde la ciudad más cercana) como norma general se encuentra disponible en dichas Apps. Sin embargo, la funcionalidad para buscar y comprar billetes online de acceso desde/hacia el aeropuerto por superficie es todavía muy limitada.

La reducción de la congestión de vehículos y la contaminación que ellos producen en los alrededores de los aeropuertos podría venir mediante el aumento del número de pasajeros que utilizasen el transporte público. Sin embargo, las Apps que ofrecen los aeropuertos en el momento de realizar esta investigación tienen un enfoque muy limitado en ofrecer servicios que faciliten y estimulen al pasajero al uso del transporte público.

Los servicios de parking (e.g., información y reserva) en estas Apps tienen una alta prioridad y parecen ser el foco principal de ingresos comerciales de los distintos modos de transporte terrestre a/desde el aeropuerto. Estos no han implementado todavía en sus Apps servicios que les pudieran generar ingresos comerciales, a la vez que promuevan el transporte público o colectivo.

1.5.5 Conclusiones Capítulo 6

El capítulo 6 incluye un artículo titulado *Airport Service Quality using Fuzzy numbers and TOPSIS* (Calidad de servicio del aeropuerto usando números fuzzy y TOPSIS).

Este estudio contribuye al campo de conocimiento de calidad de servicio de los aeropuertos, en sus siglas en inglés ASQ (*Airport Service Quality*), mediante el uso de la base de datos de IATA *(International Air Transport Association)* Global Monitor de aeropuerto, así como a la metodología de investigación,

proponiendo un método Fuzzy TOPSIS para calcular el indicador sintético ASQ. Nuestro enfoque ha significado ser una herramienta válida para clasificar cincuenta y siete aeropuertos tipo *hub* de todo el mundo. Los aeropuertos que ofrecen la mejor calidad, junto con los que ofrecen la peor calidad, ayudan a explicar el distinto comportamiento por regiones.

El ranking generado con esta metodología produce resultados similares a los de los rankings más tradicionales generados en base a promedios. Sin embargo, se observaron diferencias importantes en la selección de los tres mejores aeropuertos. Este hecho podría tener consecuencias importantes en la lista de los aeropuertos que se llevan los premios por ofrecer las calidades más altas de servicio.

Otra buena contribución de este estudio es la demostración del uso de la elasticidad de calidad de servicio SQ (en sus siglas en inglés) en la búsqueda y mejora de programas de servicio de calidad SQ para el futuro. Usando este método, este estudio analiza la elasticidad SQ para un grupo de aeropuertos. Se concluye, después de analizar las puntuaciones de calidad de servicio de un conjunto de aeropuertos, que este método puede utilizarse para identificar los atributos clave de calidad de servicio que se necesitan mejorar en cada caso. Los aeropuertos deberán concentrarse en analizar y mejorar aquellos atributos que contribuyen a un mayor incremento de SQ para sus pasajeros. En este respecto, no hay recetas mágicas y cada aeropuerto tiene que analizar estos atributos clave SQ. Otro hallazgo de este estudio es el hecho de que ciertos atributos son responsabilidad de otras organizaciones como pueden ser operadores de handling, compañías aéreas, seguridad y control de pasaportes. Por esta razón, es importante que los programas de ASQ puedan estar coordinados con los diferentes agentes presentes en el aeropuerto, ya que estos podrían tener objetivos y cultura distinta a la del operador aeroportuario.

1.6 Limitaciones, contribución y líneas futuras de investigación

Las conclusiones expuestas en al apartado anterior deben de tener en cuenta ciertas limitaciones que acompañan a esta investigación y que se exponen a continuación (sección 1.6.1). Por otro lado, la investigación contribuye al

estado del arte de varias maneras que son incluidas en la sección 1.6.2. Finalmente, esta investigación permite vislumbrar algunas posibles líneas de investigación futuras y son incluidas en la sección 1.6.3 .

1.6.1 Limitaciones de esta investigación

Una limitación importante de esta investigación es el hecho de que la tecnología de internet y especialmente para dispositivos móviles ha cambiado muy rápidamente desde que se comenzara esta investigación en 2010. Esta limitación ha sido parcialmente superada dividiendo la investigación en cuatro artículos independientes.

Todas las bases de datos de aeropuertos utilizadas para esta investigación incluyen aeropuertos de distintas regiones del mundo. Aunque el negocio aeroportuario es un negocio similar en los distintos rincones del mundo, puede también haber diferencias importantes como por ejemplo la penetración de dispositivos móviles con internet entre los pasajeros.

Para llevar a cabo esta investigación se utilizó un único sistema operativo de móvil (i.e., iOS de Apple con los modelos iPhone3 primero y iPhone5 después) para recoger manualmente los datos primarios de esta investigación de los sitios web y las Apps de los aeropuertos. El servicio podría ser diferente para los distintos sistemas operativos y modelos de dispositivos móviles con internet. Este hecho fue evidente en el caso de Japón, cuando en 2011 no fue posible evaluar la solución de internet móvil del aeropuerto internacional de Tokio Narita porque sólo suministraba servicios móviles para el estándar japonés i-mode, que no podía verse en un dispositivo iPhone.

La muestra de los aeropuertos utilizados sólo incluye los aeropuertos medianos, grandes y muy grandes. Los servicios de internet móvil parecen a priori más relevantes para los aeropuertos más grandes, pero incluir aeropuertos más pequeños en la muestra podría ayudar a comprobar si el tamaño está o no relacionado con el grado de innovación de un aeropuerto. Otra limitación de dicho estudio sobre la innovación es que sólo fue posible analizar tres características del aeropuerto que pudieran estar relacionados con

su grado de innovación (tamaño, región geográfica donde está situado y los ingresos comerciales por pasajero que genera).

En la investigación realizada sobre la calidad de servicio de los aeropuertos (ASQ en sus siglas en inglés) existen varias limitaciones. Para empezar, la base de datos es sin duda demasiado antigua, y aunque se ha intentado por todos los medios conseguir una más reciente, esto no ha sido posible. Los veinticuatro atributos utilizados en el análisis podrían no ser suficientes para el cálculo del ASQ y alguno de los otros atributos incluidos en la encuesta de ACI-ASQ podría ser un buen complemento. Con suerte, estos inconvenientes son parcialmente compensados con el amplio número pasajeros en la muestra.

Uno de los objetivos originales de esta investigación era la posibilidad de combinar los servicios de internet para dispositivos móviles con el ASQ. Por ejemplo, que los pasajeros pudieran acceder a un cuestionario desde sus dispositivos móviles para agilizar el proceso de toma y precisión de los datos. Dicho plan no se pudo llevar a cabo porque era necesaria una colaboración con un aeropuerto para implementarlo, y ésta no ha sido posible establecerla durante el periodo de esta investigación. Finalmente, el autor decidió hacer una investigación sobre ASQ, independiente del uso de los servicios de internet para dispositivos móviles, que pueda contribuir al área de conocimiento de ASQ.

Las conclusiones extraídas sobre el desarrollo de vínculos entre la industria y la investigación academia se basan en una muestra muy limitada (es decir, 5 aeropuertos y 2 programas de prácticas en empresas). Lo mismo ocurre con el uso de herramientas tecnológicas (blog y video) que contribuyeran a facilitar la investigación y la diseminación de conocimiento. En ambos casos, el autor es consciente de las limitaciones científicas de dichas conclusiones, sin embargo también está convencido de que ambos objetivos han contribuido a enriquecer sus habilidades de investigación y difusión del conocimiento.

1.6.2 Contribución al estado del arte

La principal aportación de esta tesis es la de enriquecer el área de la investigación sobre gestión aeroportuaria, iniciando una nueva línea de

investigación sobre la adopción y evaluación sitios web móviles y Apps; así como analizar cómo dichos servicios contribuyen a superar algunos de los desafíos que tienen los aeropuertos.

Esta investigación ha supuesto la generación de una buena cantidad de datos primarios sobre los sitios web de aeropuertos, sitios web para móviles y aplicaciones móviles. Se han generado datos de tres momentos en el tiempo (2011, 2013 y 2014) y se encuentran disponibles para la investigación futura, en un repositorio abierto con la licencia de Creative Commons (aeriport.com)

En el Capítulo 4 se define un nuevo modelo de innovación, que se basa en la teoría de la adopción y la difusión de la innovación. Este modelo se aplicó con éxito en esta investigación para identificar aeropuertos que pueden considerarse realmente innovadores y podría aplicarse para analizar tanto otras innovaciones adoptadas por los aeropuertos, como en otras industrias.

Los problemas del acceso por superficie a los aeropuertos (Capítulo 6) han sido ampliamente investigados, la originalidad y aportación de dicho trabajo es el análisis de las Apps móviles de los aeropuertos como una herramienta potencial que pudiera contribuir a solucionar dicho problema.

1.6.3 Líneas futuras de investigación

La tecnología de internet para dispositivos móviles evoluciona rápidamente y también los servicios para dichos dispositivos móviles suministrados por los aeropuertos a sus pasajeros. Esto hace que esta nueva línea de investigación, sobre los servicios de internet móvil por parte de los aeropuertos, dentro del área de gestión de aeropuertos, ofrezca oportunidades interesantes para futuras de investigaciones. Un ejemplo concreto podría ser el uso de la misma base de datos de aeropuertos y la repetición de esta investigación en otro momento en el tiempo para así analizar y comparar tanto los niveles de adopción, como las nuevas prácticas adoptadas.

En esta investigación se analizaron tanto los sitios web para dispositivos móviles, como las Apps móviles de los aeropuertos. Estos dos servicios, sin embargo, no se compararon entre sí, para saber cuál es el servicio preferido por parte de los pasajeros. Dicha línea de investigación se ha llevado a cabo en

otros sectores, como por ejemplo en el acceso a la información de las bibliotecas (Shun Han Rebekah Wong, 2012) y se cree que representa una opción atractiva para la investigación futura en el sector de aeropuertos.

Podrían existir otras variables – diferentes del tamaño, la región geográfica y los ingresos comerciales unitarios – relacionadas con los aeropuertos innovadores y que pudiesen analizarse en el futuro. Por ejemplo, el tipo de rutas del aeropuerto, la importancia de las líneas de bajo coste (LCC en sus siglas en inglés) tipo y número de destinos, el tipo de propiedad y gestión del aeropuertos, el presupuesto que los aeropuertos dedican a las tecnologías de la información respecto al total, el número de empleados en marketing o de I+D son otras variables potenciales que podrían también ser analizadas en investigaciones futuras.

Otro tema interesante para futuras investigaciones es el análisis de la complementariedad de la innovación de los aeropuertos con otros agentes implicados en el turismo y los viajes, especialmente para aquellos destinos que dependen en gran medida del transporte aéreo, como por ejemplo los aeropuertos de las islas. Algunas indicaciones podrían ser obtenidas de las sinergias existentes entre las industrias del turismo y los viajes, en relación con las redes sociales, especialmente Facebook y Twitter. Los aeropuertos hacen todavía poco uso de las redes sociales para comunicar campañas de marketing a los pasajeros, y el número de comunicaciones en sus blogs sigue siendo muy baja, pero de acuerdo a Wattanacharoensil & Schuckert (2015), más atención debe darse a este aspecto de la comunicación del aeropuerto. Por lo tanto, este problema también podría ser utilizado para analizar otros procesos de innovación.

En el área de calidad de servicio de los aeropuertos (ASQ en sus siglas en inglés) se recomienda en el futuro desagregar los atributos en diferentes conjuntos, entre grupos de pasajeros que respondan a un mismo perfil. Por ejemplo, sería conveniente obtener indicadores ASQ para pasajeros de salida, llegada y en conexión, pasajeros de negocios y de vacaciones, o cualquier otro perfil de interés para los gestores de los aeropuertos. Estos aspectos parecen ser importantes retos para futuras investigaciones en el área de ASQ.

Por último, ya que la tendencia es que todos los pasajeros viajen con un dispositivo móvil con acceso a Internet en un futuro muy próximo (81% en 2014 según la IATA) y hay una interacción cada vez mayor entre los pasajeros, los aeropuertos y otros proveedores de viajes a través de redes sociales (e.g. Twitter), hay una buena oportunidad para tratar de medir su opinión sobre el ASQ observando las preguntas y los comentarios con opiniones que dejan los pasajeros durante dichas interacciones.

1.7 Referencias

Abeysekera, L., & Dawson, P. (2015). Motivation and cognitive load in the flipped classroom: definition, rationale and a call for research. Higher Education Research & Development, 34(1), 1–14. http://doi.org/10.1080/07294360.2014.934336

ACI. (2015). Airport Council International (ACI). Retrieved October 28, 2015, from http://www.aci.aero/About-ACI

ACI - ASQ. (2015). Airport Council International (ACI) Airport Service Quaility (ASQ). Retrieved October 28, 2015, from http://www.aci.aero/Airport-Service-Quality/ASQ-Home

ACI EUROPE. (2015). ACI EUROPE Membership Programs. Retrieved October 28, 2015, from https://www.aci-europe.org/membership/members-list.html

ACRP. (2015). Airport Cooperative Research Program (ACRP) managed by Transport Research Board (TRB). Retrieved October 7, 2015, from http://www.trb.org/ACRP/ACRP.aspx

Aéroports de Paris. (2009). My Airport –Official Aéroports de Paris service. Retrieved June 30, 2014, from https://itunes.apple.com/gb/app/my-airport-the-official-aeroports/id322543617?mt=8

Aéroports de Paris. (2015). My Airport –Official Aéroports de Paris service on the App Store. Retrieved October 28, 2015, from https://itunes.apple.com/app/my-airport-service-officiel/id322543617?mt=8

Airbus. (2014). Global Market Forecast 2014-2033 | Airbus, a leading aircraft manufacturer. Retrieved May 19, 2015, from http://www.airbus.com/company/market/forecast/

Apple. (2007). Apple Reinvents the Phone with iPhone. Retrieved February 15, 2011, from https://www.apple.com/pr/library/2007/01/09Apple-Reinvents-the-Phone-with-iPhone.html

ATAG. (2014). Aviation Benefits Beyond Borders - Powering global economic growth, employment, trade links, tourism and support for sustainable development through air transport. Retrieved from http://aviationbenefits.org/

Budd, T., Ison, S., & Ryley, T. (2011). Airport surface access in the UK: A management perspective. Research in Transportation Business & Management, 1(1), 109–117.

CAA UK. (2009). UK Airport Statistics. Retrieved January 31, 2011, from http://www.caa.co.uk/default.aspx?catid=80&pagetype=88&pageid=3&sglid=3

Chiou, W.-C., Lin, C.-C., & Perng, C. (2010). A strategic framework for website evaluation based on a review of the literature from 1995-2006. Information & Management, 47(5-6), 282–290. http://doi.org/doi: DOI: 10.1016/j.im.2010.06.002

DFW. (2009). DFW International Airport Debuts Mobile Web Site. Retrieved September 8, 2014, from http://www.dfwairport.com/pressroom/Debuts_Mobile_Web_Site.pdf

EU Research. (2006). Mobility of researchers between academia and industry. Retrieved from http://ec.europa.eu/euraxess/pdf/research_policies/mobility_of_researchers_light.pdf

Fernandes, E., & Pacheco, R. R. (2008). A quality approach to airport management. Quality & Quantity, 44(3), 551–564. http://doi.org/10.1007/s11135-008-9212-9

Frambach, R. T., & Schillewaert, N. (2002). Organizational innovation adoption: a multi-level framework of determinants and opportunities for future research. Journal of Business Research, 55(2), 163–176. http://doi.org/doi: DOI: 10.1016/S0148-2963(00)00152-1

Graham, A. (2009). How important are commercial revenues to today's airports? Journal of Air Transport Management, 15(3), 106–111. http://doi.org/doi: DOI: 10.1016/j.jairtraman.2008.11.004

Graham, A. (2013). Managing airports: an international perspective. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&scope=site&db=nlebk&db=nlabk&AN=652617

Ho, C.-I., & Lee, Y.-L. (2007). The development of an e-travel service quality scale. Tourism Management, 28(6), 1434–1449. http://doi.org/doi: DOI: 10.1016/j.tourman.2006.12.002

IATA. (2015). Aim of the International Air Transport Association (IATA). Retrieved October 28, 2015, from http://www.iata.org/about/Pages/index.aspx

IDPF. (2015). IDPF - International Digital Pubish Forum. Retrieved October 1, 2015, from http://idpf.org/epub

Internet Worldstats. (2015). Interent World Statistics. Retrieved from http://www.internetworldstats.com/stats.htm

Law, R., Qi, S., & Buhalis, D. (2010). Progress in tourism management: A review of website evaluation in tourism research. Tourism Management, 31(3), 297–313.

Manataki, I. E., & Zografos, K. G. (2009). A generic system dynamics based tool for airport terminal performance analysis. Transportation Research Part C: Emerging Technologies, 17(4), 428–443. http://doi.org/doi: DOI: 10.1016/j.trc.2009.02.001

Martín-Domingo, L., Adiloglu, L., Erturk, M., & Peksatici, O. N. (2015). Istnbul Hub Seminar: How Istanbul plans to become a major aviation center? Retrieved October 18, 2015, from https://eresearchm.ozyegin.edu.tr/xmlui/handle/10679/924

Moneyterms. (2015). RPK (Revenue Passenger Kilometres). Retrieved October 28, 2015, from http://moneyterms.co.uk/rpk-revenue-passenger-kilometres/

Okazaki, S., & Hirose, M. (2009). Does gender affect media choice in travel information search? On the use of mobile Internet. Tourism Management, 30(6), 794–804. http://doi.org/doi: DOI: 10.1016/j.tourman.2008.12.012

Orfila-Sintes, F., Crespo-Cladera, R., & Martinez-Ros, E. (2005). Innovation activity in the hotel industry: Evidence from Balearic Islands. Tourism Management, 26(6), 851–865. http://doi.org/doi: DOI: 10.1016/j.tourman.2004.05.005

Park, Y. A., & Gretzel, U. (2007). Success factors for destination marketing web sites: A qualitative meta-analysis. Journal of Travel Research, 46(1), 46.

Prince, M. J., & Felder, R. M. (2006). Inductive teaching and learning methods: Definitions, comparisons, and research bases. JOURNAL OF ENGINEERING EDUCATION-WASHINGTON-, 95(2), 123.

Rendeiro Martín-Cejas, R. (2006). Tourism service quality begins at the airport. Tourism Management, 27(5), 874–877. http://doi.org/10.1016/j.tourman.2005.05.005

Rogers, E. M. (1995). Diffusion of innovations. The Free Press.

Scolari, C. A., & Fernández-Cavia, J. (2014). Mobile Applications and Destination Branding in Spain. International Journal of Interactive Mobile Technologies (iJIM). Retrieved from http://online-journals.org/index.php/i-jim/article/view/3575

Shun Han Rebekah Wong. (2012). Which platform do our users prefer: website or mobile app?null. Reference Services Review, 40(1), 103–115. http://doi.org/10.1108/00907321211203667

SITA. (2012). Passenger Self-Service Survey 2012 | SITA.aero. Retrieved from http://www.sita.aero/surveys-reports/industry-surveys-reports/passenger-self-service-survey-2012

SITA. (2013). Passenger IT Trends Survey 2013 | SITA.aero. Retrieved from http://www.sita.aero/surveys-reports/industry-surveys-reports/passenger-it-trends-survey-2013

SITA. (2014). The passenger IT Trends Survey 2014 | SITA.aero. Retrieved from http://www.sita.aero/resources/type/surveys-reports/passenger-it-trends-survey-2014

SITA. (2015). The passenger IT Trends 2015. Retrieved from http://www.sita.aero/resources/type/surveys-reports/passenger-it-trends-survey-2015

Tornatzky, L. G., & Klein, K. J. (1982). Innovation characteristics and innovation adoption-implementation: A meta-analysis of findings. IEEE Transactions on Engineering Management, 29(1), 28–45.

Wattanacharoensil, W., & Schuckert, M. (2015). How Global Airports Engage Social Media Users: A Study of Facebook use and its Role in Stakeholder Communication. Journal of Travel & Tourism Marketing, 32(6), 656–676. http://doi.org/10.1080/10548408.2014.955245

2 INTRODUCTION

Thesis General Abstract

Airports are facing different challenges such as guiding passengers to, from and within the airport; developing commercial revenue and providing good airport quality of service. Simultaneously, Internet has changed the way of doing business in many industries, including the airport industry and now more than 80% of air of passengers travel with Internet mobile devices. The purpose of this thesis is to monitor the adoption of mobile websites and mobile Apps by airports, to identity real innovator airports and to analyze if these mobile services are contributing to overcome some of the challenges airports are facing.

This research analyzes some of the largest airports in the world from a laboratory. Using an innovation theoretical model, the study tests whether airports early adopters of mobile Internet can be considered real innovators. The evaluation of airport mobile websites and Apps is carried out using tourism research evaluation models, adapted for the airport context.

Findings show that airports are adopting these Internet mobile services (69% in January 2014), but at a slower pace than in other tourism industries such as hotels or airlines. Airport mobile Internet services include mainly information services with very limited ticketing and information functionality aiming to develop commercial revenue. Early adoption of airport mobile Internet services is not found to be related to an airport`s size, but it is found to be related to commercial revenue and geographical location. North American and European airports are more likely to provide these mobile solutions and four European airports are found to be real innovators (London Heathrow, London Stansted, Amsterdam Schiphol and Copenhagen airport).

Keywords**:** Airport, web, mobile, Apps, Internet, commercial revenue, airport quality of service, ASQ, evaluation

2.1 Motivation and Objectives

Airport mobile Internet refers to Internet services provided by airports to serve passengers traveling with a smartphone. Those services include mobile websites or/and mobile applications (Apps). The scope of this research is the analysis of the adoption by airports of these new services as well as its content.

Figure 2-1. *Airport mobile Internet*[15]

Air transport is a very dynamic industry, the demand for air passengers was doubled during the last 15 years, reaching more than 3 billion in 2014 (ATAG, 2014). This is expected that the number of air passengers will double again in the next 15 years (Airbus, 2014). All those passengers need to use some of the 4000 airports around the world.

Airports have evolved from public utilities into a commercialized and in some cases privatized entities. Commercial airports have now an increasing pressure from both, its customer airlines to keep competitive prices and its shareholders to be profitable. One way to please both stakeholders has been to increase commercial revenue (Graham, 2009).

[15] All figures have been created by the author, otherwise source is indicated.

Airports, while adapting their capacity to meet the new demand, have been expanding facilities (Budd et al., 2011). With the aim to develop commercial revenue, the growth in commercial areas has been often greater than the passenger growth. For instance, during the 1990-2008 period the Heathrow, Gatwick, Stansted and Glasgow airports in the UK increased by 150 percent the commercial space (Graham, 2009), while passengers numbers increased only by 98 percent (CAA UK, 2009). Thus, the option to increase the commercial density area of terminals is now more limited (Graham, 2009) and the complexity of passengers flow through the airport has increased (Manataki & Zografos, 2009).

The profound structural changes observed in the industry, such as commercialization, privatization, globalization and competition have encouraged airports to place more emphasis on quality (Graham, 2013). Airport service Quality (ASQ) is also a good indicator for the tourism industry and the image of a particular destination, as the first contact of the tourist usually starts at the airport (Fernandes & Pacheco, 2008; Rendeiro Martín-Cejas, 2006).

Taking into account the above considerations, airports are facing some of the following challenges:

- Developing commercial revenue
- Guiding passengers smoothly throughout the airport terminal
- Reducing congestion and pollution in the journey legs to and from the airport
- Providing high airport service quality (ASQ)

Simultaneously, during the last 15 years Internet has changed the way of doing business in many industries, including the tourism industry (Ho & Lee, 2007). From 2000 to 2015 the number of Internet users worldwide has increased almost 10 fold, passing from 360 million to 3.2 billion users (Internet Worldstats, 2015). A most recent trend is the Internet access through mobile devices.

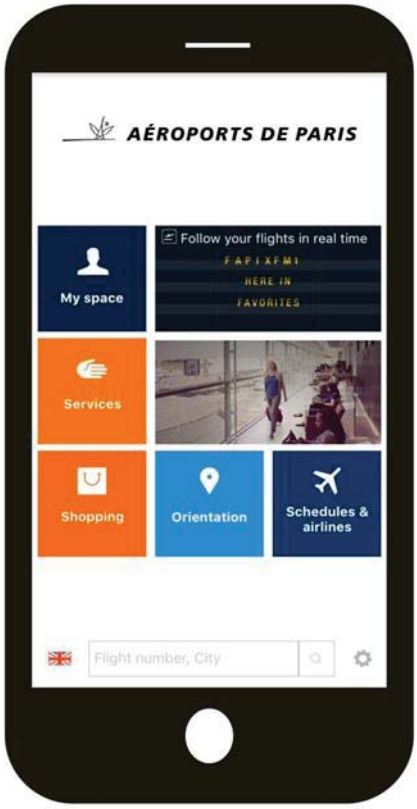

Figure 2-2. Aéroports de Paris iPhone App as Oct 2015 (Aéroports de Paris, 2015)

Mobile Internet started to be used in Japan in the late 1990's, but it did not gain popularity in the travel information search until the late 2000's (Okazaki & Hirose, 2009). One important milestone was the launch of the first iPhone in 2007 (Apple, 2007). Year 2009 saw some of the first airports adopting mobile Internet services. For instance, Dallas/Fort Worth International airport in the USA introduced its first mobile website (DFW, 2009) and Aéroports de Paris in France its first iPhone App (Aéroports de Paris, 2009). One screen shoot of the Aéroports de Paris iPhone App can be seen in Figure 2-2. Since 2009, the penetration of air passengers travelling with smartphone has increased very quickly; reaching 81% in 2014 (see Figure 2-3).

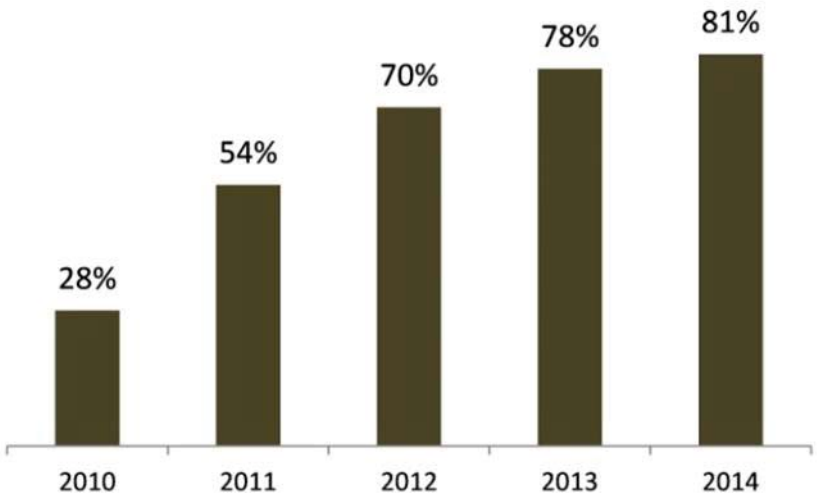

Figure 2-3. Smartphone penetration for air passengers based on (SITA, 2012, 2013, 2014b, 2015)

The aim of this thesis is to analyze how these new mobile services are contributing to overcome some of the challenges airports are facing. At the same time, it aims to start a new line of research within the airport management field. Being more specific:

- Are airports actively adopting these new Internet mobile services?
- Are these new services contributing to increase airport quality of services (ASQ) and in particular guiding passengers inside and outside the airport while developing commercial revenues?

The objectives of this research were from the beginning beyond the analysis of the airport mobile Internet research topic. The author considered that in addition to gain the necessary research skills it was important to try to develop links between academia and the airport industry, as well as to explore technological tools that can help not only to carry out the research, but also to disseminate it.

Within academia and in order to complete a PhD program, the purpose is to prepare a piece of original research. In this particular case, considering some of the challenges airports are facing and the new mobile Internet services provided by airports, the objectives are:

- To study the adoption of mobile websites and mobile Apps by airports overtime.
- To evaluate these new mobile Internet service from different viewpoint: Moment of adopting, degree of implementation, scope and quality of service and airport service quality (ASQ).

By carrying out this research, the author aimed to gain the research skills necessary to carry out research independently. However, one important part of academia is to be able to communicate knowledge, which often takes place in the classroom. Thus, another objective was:

- To combine research (on a part time basis) with lecturing

European institutions throughout different programs have tried to develop links between academia and industry. For instance, in 2006, a combined group of experts from industry, institutions and research institutes from EU member states defined twelve recommendations to promote the mobility of researchers between academia and industry (EU Research, 2006). In the USA, the Airport Cooperative Research Program (ACRP, 2015) uses research to try to solve airport issues.

The author had gained over 10 years of working experience in the air transport industry before joining this PhD program in 2010. He believed, and it was one strong reason for him to joint this program, that closer links should exist between the industry and academia.

The objectives, aiming to develop links between academia and the airport industry, were to try:

- To establish cooperation with one airport interested on the airport mobile Internet research topic.
- To define and carry out a piece of research on this field relevant to the airport and compatible with the academia requirements to fulfill a PhD program.

Academic research requires of a minimum set of tools necessary to complete a PhD program. For instance, this is necessary to use a Word processor to write this document. However, there are other tools which are not strictly necessary,

but can contribute to facilitate the research and dissemination of the researched knowledge.

In addition, the research topic *Airport Mobile Internet* involves new technology that can be used not only by airports, but also in other fields like academia. For instance, you can use a smartphone to read a research paper, however the file document should be ideally on a format suitable for mobile devices such as EPUB (IDPF, 2015) or MOBI in case of a Kindle device. So, the following objective was defined:

- To use new technological tools that would lead to facilitate the research process and can contribute to smooth the dissemination of knowledge.

2.2 Methodology

The mobile Internet environment has changed very quickly as described in section 2.1. It was already expected when this research started back in 2010. Thus, it was decided to approach the research as an amalgamation of separate research papers as described in section 2.3.

The research methodology aimed to achieve the objectives defined in the previous section. Each of the four papers included (chapter 3, chapter 4, chapter 5 and chapter 6), contain the detailed methodology used in each case and this section provides a summary. In addition, it includes the research strategy used to try to establish links with the airport industry and two of the technological tools used during this research.

This research used quantitative methods with a combination of primary and secondary data. The secondary data set used for chapter 3, chapter 4 and chapter 5 is composed of an airport database from airports association Airports Council International (ACI), in which the total number of passengers, International passengers, the geographical location of each airport, and the size of the airport were included. This database was complemented with commercial revenue data for each of the airports and extracted from different sources (Airport annual reports, FAA, ICAO and ACI), as well as airports website addresses collected from a Lab (Laboratory). In chapter 6, an airport quality of service (ASQ) database from the International Air Transport Association (IATA) was used.

A basic Lab, composed of Internet access, a laptop computer and a mobile device (iPhone) was used to collect primary data about airport websites, mobile websites and mobile Apps (applications).

Academic researchers have been using website evaluation methods[16] since the mid 1990's in different fields (Chiou et al., 2010). The tourism industry has been using this technique in several sectors and Law et al. (2010) identified the following: Hospitality websites, destination websites, travel supplier websites, airline websites, online travel guides, online travel magazines, travel websites, travel search engine websites and Travel blogs. However, academic research on evaluation websites, mobile websites and Apps was not found for airports.

The methodology used to evaluate airport websites, mobile websites and applications was to adapt research models used in the tourism research to the airport context. This is represented by the illustration in Figure 2-4.

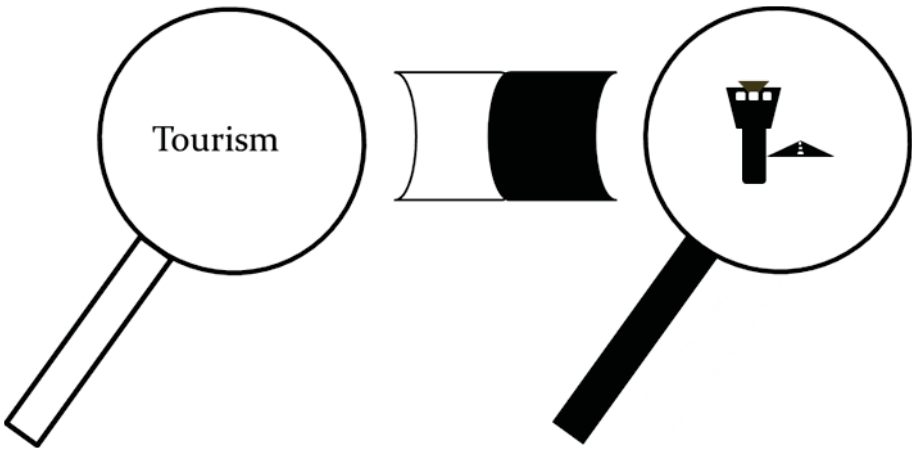

Figure 2-4. website and mobile Apps evaluation models from the tourism industry applied to airport

[16] website evaluation can be defined as "the act of determining a correct and comprehensive set of requirements, ensuring that a website provides useful content that meets user expectations and setting usability goals" (Law et al., 2010, p. 297).

In chapter 3, in order to evaluate websites for airport mobile devices three success factors used by Chiou et al. (2010) and based on a review of articles on the web site evaluation by Park and Gretzel (2007) were used: Easy access to the site, quality of information and persuasion to commercial information of 22 airport mobile web sites were assessed. In chapter 4, two factors (easy access to the site and persuasion) were used to evaluate both, websites for PC and websites for mobile devices. In chapter 5, 31 iPhone App of some of the largest European airports were evaluated in the lab using the evaluation model of destinations mobile applications (Scolari and Fernández-Cavia 2014) and adapted for the airport surface access on airport Apps.

In chapter 4, in addition to evaluating the websites for mobile devices and to identify innovative airports, a theoretical model is defined. It is based on the theory of adoption of innovation developed by Rogers (1995). This theory takes into account only when organizations adopt an innovation and it seems not to be enough according to Frambach & Schillewaert (2002) and Tornatzky & Klein (1982). Thus, the defined model includes, in addition to the time of adoption of the innovation, the degree of implementation or sophistication (see Figure 4-5 in chapter 4). This model is applied to websites, mobile websites and mobile Apps of 75 of the largest world airports. The model identifies real innovator airports, when identified as innovators in two processes of innovation (adoption of the website to PC services and adoption of mobile Internet in this case).

Different methods of analysis are used for this research. Chi-Square goodness-of-fit and Shapiro-Wílk normality test are used to test if the airport innovation adoption follows normality. Univariate analysis and one way analysis variance based on ANOVA are used to check if size and geographical collation of airports are related to adoption of mobile services and airport innovation. The tree CART model was used to measure the effects of airport innovation on commercial revenue generation. Finally, the Fuzzy model TOPSI is used to calculate the airport service quality index (ASQI).

One aim of the author was teaching at the university, while conducting research part time. The author taught in Beijing (China) at ESEUNE's business school MBA program during three semesters (January 2012 - June 2013). The classes taught about Chinese business culture for western students were created

by the author following the *flip the classroom*[17] approach and included some of China's landmarks such as the Great Wall and the Forbidden City. In addition to those courses, he implemented the first edition of an internship program. The summer of 2013 he moved to live in Istanbul (Turkey) and began teaching in the Air Transport Management program at Ozgeying University. Here also implemented the *flip the classroom* format in his courses of Airline Management and International Aviation Management. Along with his classes, he coordinates the Erasmus program and is part of the team coordinating the internship program. He has made several initiatives to try to interest students in scientific research with various activities, one of which is the launch of the first edition of the Istanbul Hub Seminar – about the Istanbul airport system (Martín-Domingo et al., 2015).

The strategy used, to try to establish research collaboration about airport mobile Internet, was to use the author' professional contacts as well the Cranfield University Air Transport LinkedIn group with over thousand members. Once the contact was established, the author shared his blog[18] to introduce himself and the research topic. It was followed by face to face meetings (when possible), telephone calls and email.

The use of a blog and video were selected, following the aim of using new tools that would help both, the research process and the dissemination of knowledge. For the blog, the open source Content Management System (CMS) Wordpress was chosen, two Internet domains (aeriport.mobi and aeriport.com) were purchased and hosting services were hired. The blog is active since 2011 and contains the contact details of the author, the introduction to the research topic of this research, together with posts and the research papers. The author

[17] In a flipped classroom, students watch online lectures, collaborate in online discussions, or carry out research at home and engage in concepts in the classroom with the guidance of the instructor (Abeysekera & Dawson, 2015)

[18] The URL of his blog is: www.aeriport.com

intended from the beginning to have a personal open access digital repository throughout the investigation. Figure 2-5 shows the homepage of the blog.

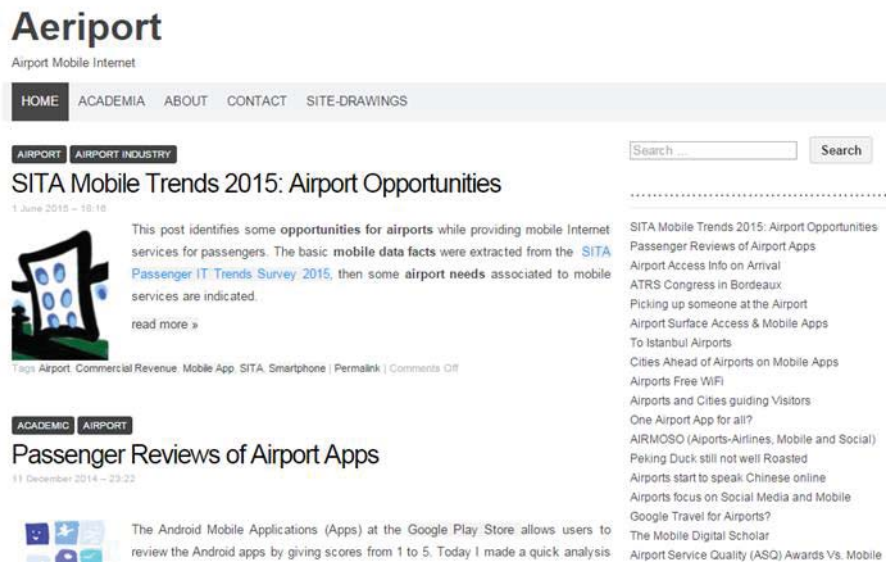

Figure 2-5. Author's blog screenshot – www.aeriport.com

For the video, the author created his own channel on the Youtube platform (Youtube.com). There, he has the videos related to this research as well as videos used for his flipped Air Transport Management courses in Istanbul. For the videos used in China he used a different video platform, as the access to Youtube is restricted from China's mainland (i.e., territory of the People Republic of China, except Hong Kong and Macao). There, the Chinese video platform Youku (youku.com) was used. To generate videos, firstly, presentations were created with Microsoft PowerPoint and then videos were created using the App for tablets ExplainEverything (explaineverything.com).

2.3 Thesis Structure

Two things affecting the thesis structure are: (1) The core of this thesis is composed of four separated research papers; and (2) It is written in English, providing the first chapter in Spanish. Taking these two peculiarities into account, the thesis is organized as follows.

The first chapter (chapter 1) written in Spanish, includes an overview of this research, this is followed by the rest of the thesis in English. This second chapter (chapter 2) includes the introduction of the thesis. Each of the next four chapters (chapter 3, chapter 4, chapter 5 and chapter 6) includes one of the four research papers included. The last chapter (chapter 7) includes the general findings, research limitations, contributions and future lines of research.

The titles of each of the four research papers included are:

- Chapter 3: Airport Mobile Website Evaluation: Terminal Navigation & Commercial Revenue
- Chapter 4: Airport Mobile Internet as an Indication of Innovation
- Chapter 5: Airport Surface Access and Mobile Apps
- Chapter 6: Airport Service Quality using Fuzzy numbers and TOPSIS

3 Airport Mobile Website Evaluation: Terminal Navigation & Commercial Revenue

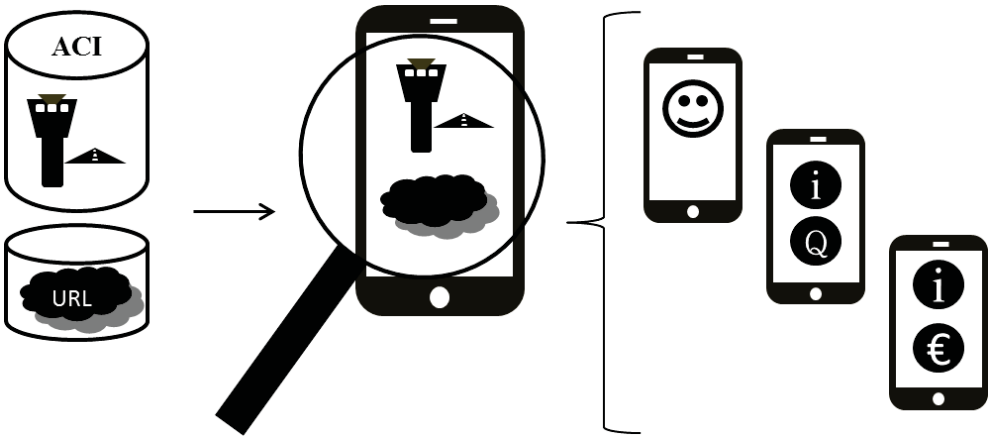

Figure 3-1. Illustration abstract: Airport mobile website evaluation - Terminal navigation and commercial revenue

Abstract

This paper explores the status of airport mobile website as a potential new service to help airports to overcome the double challenge of guiding passengers throughout the airport while keep developing commercial revenue. Taking the 100 largest airports in the world identifies which airports provide mobile websites to its passengers. Using website evaluation methods assess 22 airport mobile websites on ease access, quality of information and commercial information. The findings show that larger European and North American airports are more likely to provide airport mobile services; European airports provide a higher quality of information to guide passengers; and airport mobile websites are not yet actively used to inform and promote airport retailing services.

Keywords: Airports, wayfinding, commercial revenues, mobile, Internet, website, Apps, evaluation,

3.1 Introduction

The evolution of the airport sector from a public utility to a commercialised, and in some cases privatised industry, has given airports greater freedom, expertise and motivation to exploit the commercial opportunities. At the same time, there has been an increasing pressure from the airline industry for airports to control their aeronautical revenue and give them reason to develop commercial revenues (Graham 2009). Airports' growth in the commercial areas at a faster rate than passengers rate, contributes to increase the complexity of passenger flow through the airport (Manataki & Zografos, 2009). Thus, keep developing airport commercial revenue while facilitating a smooth flow of passengers through the airport has become a challenge.

Internet has changed the way of doing business in the tourism industry (Ho and Lee 2007) and the number of users keeps growing. From 2000 to 2010 the number of Internet users Worldwide has been multiplied by 5.5 times, passing from 360 million Internet users in year 2000, to almost 2.000 million Internet users in 2010 (Miniwats, 2011).

The rapid increased of Internet users also include those using mobile devices. For instance, Facebook in November 2010 announced as its blog that more than 200 million people accessing Facebook from their mobile devices. Nine months before (Feb 2009) the figure was half, 100 million, and one year before (January 2009) there were 20 million mobile users. This means that in less than two years the number of Facebook mobile users increased 10 times - from 20 to 200 Million people (Facebook, 2011).

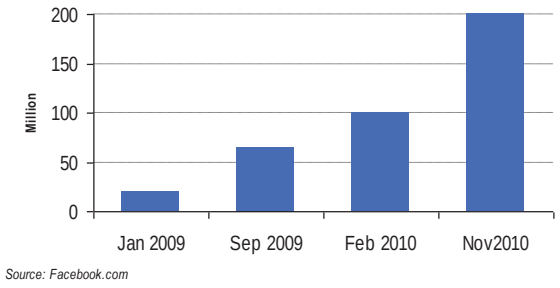

Figure 3-2. Facebook's mobile users

The Air Transport Industry has been specially influenced by Internet. Now is common to use the Internet to book an airline ticket, to check-in before the flight or to book airport parking space. For example, 60% of passengers flying with the Spanish low cost airline Vueling during 2009 booked their tickets at the Internet (Vueling, 2009).The percentage of travellers goes up to 99% in the case of the Irish low cost airline (Ryanair, 2009).

Most airports have now websites and recently have started to provide services for mobile Internet users. For instance Manchester airport in the UK (MAN) and San Francisco airport in the US (SFO) launched free application for iPhone users in 2010 (iTunes Apple Store). Others, like Atlanta (ATL) in the US, Frankfurt (FRA) in Europe and Seoul Incheon (ICN) in Asia provide mobile websites.

A mobile websites is normally a simple version of the regular website accessed from PCs. These sites usually have a limited number of services and content information provided at the full PC website. Figure 3-3 below shows one example of the mobile website of Seoul's Incheon International airport in South Korea.

Figure 3-3. Mobile site at Seul Incheon airport

The provision of a mobile site can allow most of smartphone users access the airport web content, independent of the smartphone operating system. The acceptance of this mode of access to Internet content seems to be high. A survey carried out by the French mobile operator (Orange, 2010) found that

70% of smartphone users in the UK preferred to use the browser instead of applications.

Academic researchers have been using website evaluation methods since the mid 1990's in different fields (Chiou et al., 2010). website evaluation can be defined as "the act of determining a correct and comprehensive set of requirements, ensuring that a website provides useful content that meets user expectations and setting usability goals" (Law, Qi & Buhalis, 2010). This technique has been applied into the tourism industry and the following sectors were identified: Hospitality websites, destination websites, travel supplier websites, airline websites, online travel guides, online travel magazines, travel websites, travel search engine websites and Travel blogs (Law, Qi & Buhalis, 2010). website evaluation research for airport websites was not founded.

This paper aims to fill the gap of website evaluation of airport websites, by evaluating airport mobile websites accessed with smartphones. Simultaneously, it pretends to observe how this new service helps airports to overcome the double challenge of facilitating the navigation of passenger throughout the airport facilities, while developing commercial revenue. Thus, the assessment tries to give answer to the following questions:

- *Mobile website penetration:* Are mobile websites extensively offered by airports?
- *Information quality:* Is there a variety of information provided to airport smartphone users?
- *Commercial offering:* Are airport smartphone users offered with commercial information and services?

In order to give answer to the above questions a laboratory assessment of airport websites and mobile websites was carried out.

3.2 Methodology

The methodology used to evaluate airports mobile websites was done in three steps: 1) An airport database from airport association ACI was used to select the airports; 2) Airport mobile website addresses were founded; and 3) Airport mobile website were evaluated using Park and Gretzel (2007) success factors for destination marketing websites and adapted for the airport environment.

The sample of airports was extracted from the 100 largest airports worldwide by number of passengers during 2009 (ACI, 2009). To select the sample, it was assumed that the provision of information to passengers, while passing through the airport, was more relevant for larger than for smaller airports as walking distances tend to be larger and guidance services at larger airports becomes more critical.

The original set of data included airports from over the world, as the airport business is a similar business across the word. In addition, larger airports tend to have a larger number of international airlines and passengers whom will demand similar services at the different airports across the world.

The initial sample of 100 airports was grouped by regions used by ACI (Airport Council International): North America (31), Latin America and Caribe (4), Europe (26), Middle East (5) and Asia Pacific (33). The regions with very limited sample were discarded and the 90 airports from North America, Europe and Asia Pacific were considered.

The final sample included 90 airports with more than 10 million passengers in 2009. The sample was divided into two groups ("XL" and "L") attending to ACI's grouping (Table 3-1), based on size.

Table 3-1. Airport categorization by size

Airport Group	Passengers a year [million]	Label
1	> 25	XL
2	10 - 25	L
3	5 - 10	M
4	< 5	S

Source: Airport Association ACI

The technical equipment used for the research was a laptop, Internet access and one smartphone (iPhone 3.0) with WiFi access. The data was gathered between January and February 2011 from a laboratory in Beijing (China). First, the search engine Google was used to look for each of the airports official websites. Then, each of the website addresses was loaded into the smartphone.

Each of the 90 airport websites was accessed from the smartphone and the laptop in order to identify which sites had a mobile site. A total of 23 airports were identified to have a mobile site (25.6%). The website evaluation assessment was carried only to 22 airports as Narita's airport mobile site was only available for the Japanase i-mode standard and not for the iPhone used.

The main objective of this airport website evaluation was to measure the content richness. Law et al. (2007) carried out a review of website evaluation research in the tourism industry and founded out five evaluation approaches: counting, automated, numerical computation, user judgment, and combined methods. The counting approach seemed appropriated for the aim of this paper.

Park & Gretzel (2007) carried out a qualitative meta-analysis of 153 destination marketing organization's websites. Table 3-2 below shows the list of nine unified success factors identified.

Table 3-2. website evaluation unified factors

Unified factors	Description
1.- **Ease of use**	**Usability**, accessibility, navigability, and logical structure
2.- Responsiveness	Accessibility of service, e-mail service, reply to customer, contact information, and intuitive online help
3.- Fulfillment	Order process, accu. of ser. promise, billing accu., online booking process, and confirmation, on-time delivery
4.- Security/Privacy	Information protection, online purchase security, and privacy statement
5.- Personalization	Individualized attention, customization of offerings and information
6.- Visual appearance	Attract attention, convey image, and aesthetics
7.- **Information quality**	**Variety**, scope, currency, conciseness, accuracy, authority, reliability, and uniqueness
8.- Trust	Brand recognition, consistency, intentions, and credibility
9.- Interactivity	Interactive features and communication (FAQs, guest books, chat)
10.- **Advertising/persuasion**	Marketing, **promotional content**, suggested products, recommendation, and incentives
11.- Playfulness	Enjoyment, fun, pleasure, and flow
12.- Technology integration	New technology and integration

Source: (Y. A. Park & Gretzel, 2007), (Chiou et al., 2010),

The number of factors varies among different studies. Park & Gretzel (2007) founded a range between one to sixteen factors. For this airport mobile website evaluation and considering the main question to be answered (information quality and commercial offering), three unified factors were used (Easy of use, Information quality and advertising/persuasion) and adapted to the airport environment.

For the assessment of airport mobile websites consisted on a simulation of a departure passenger arriving to the airport facilities 90 minutes or more before

the departure of his flight. In those conditions the passenger, used a smartphone (iPhone 3) and checked the information available about his flight.

Each unified factors was assessed by different description variables. 1) Ease of use was assessed by usability; 2) Information quality was assessed by the variety of information content; and 3) Advertising/persuasion was assessed by the promotional content. The variables used are shown in Table 3-3 and explained below.

Table 3-3. Airport mobile websites variables assessed

Unified factors	Variable Name	Variable Description
Ease of Use	Auto Mobile Site	When airport website diverts smartphones to the mobile site automatically
Information Quality	Airline	Airline Name
	Flight Num	Flight Number
	Airline Web Link	Link to airline's website
	Dest Name	Destination Name
	Dep Date	Date of departure of the flight
	Dep Sched Time	Departure Schedule Time
	Dep Estim Time	Departure Estimated Time
	Status	Ontime, delayed, Boarding, etc.
	Term Num Area	Terminal number and/or area
	Term Map	Maps of the terminal
	Check-in Count	Check-in desk numbers/area
	Secur Wait Time	Avg waiting time at the security point
	Gate Num	Gate Number to board the flight
Advertising	Comm info	Promotional information about shops, restaurants, etc.
	Variable values: [1] if available; [0] if not availble	

Source: Author based on Unified factors (Y. A. Park & Gretzel, 2007)

i. Easy of Use

The ISO definition of usability is: "The effectiveness, efficiency and satisfaction with which specified users achieve specified goals in particular environments" (W3C.org, 2011)

The application of the definition for our case was the efficiency with which an airport mobile users success to enter the mobile site of the airports assessed. In other words, ease access for the airport mobile website once its website address is known.

ii. Quality of Information

Among the different variables used by previous website evaluation research to assess information quality, variables referring to variety of information were used on this study (Y. A. Park & Gretzel, 2007). The variety of information was assessed by identifying the information available, for a departing passenger who travelled with smartphone and accessed the airport mobile website.

The 13 variables chosen for assessment were defined among variables shown at airport websites and which were considered to be relevant for a departing passenger relying on his smartphone to reach the boarding gate of his flight.

iii. Advertising and persuasion

One aspect of destination marketing involves inspiring people to visit places or attractions that they did not know or consider before engaging with promotional materials. websites have to help achieve this persuasion goal and their effectiveness needs to be evaluated in this respect (Y. A. Park & Gretzel, 2007). If we change "destination" for "airport retail facility", similar principle could apply for a departing passenger in an airport on his way to the boarding gate.

A passenger, when walking through the airport terminal on his way to the gate, will have commercial possibilities such as shops, restaurants and bars. If passengers use a smartphone to navigate the airport, airports mobile websites could provide customized information to persuade passengers to use airport commercial services on their way to the boarding gate.

Commercial revenue at airports includes several items: Retail, car parking, car rental, property, advertising and others (Graham 2009). This airport mobile website evaluation concentrated on retail information shown on its mobile website to a departure passenger.

After carrying out the airport mobile website evaluation, data was gathered and analysed. The results are described on the next section.

3.3 Results and Discussion

From our sample of the largest 90 airports in term of passenger numbers from North America, Europe and Asia Pacific, 100% of them had a PC website and 26% of them had a mobile website (see Figure 3-4). This percentage can be considered low if compared to research carried out two years earlier in the tourism industry, where 22% of hotels and 38% of the airlines had a mobile website (eyeforTravelResearch, 2009).

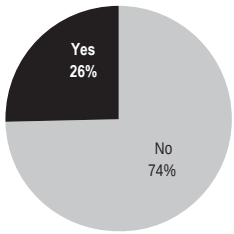

Figure 3-4. Percentage of airports with mobile website

Figure 3-5 shows that larger airports (XL) are more likely to have a mobile website (i.e. 33% vs. 18%). This finding confirms the assumption that mobile websites become more relevant as an airport increases in sizes. Other reason could be that larger airports can justify better economies of scale for their investments.

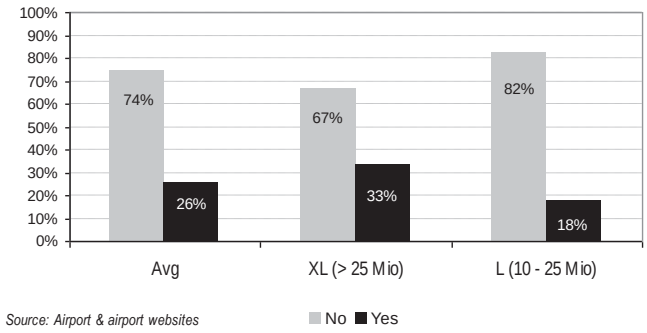

Figure 3-5. Airports with mobile website by size

When looking at regions, Europe (42%) and North America (32%) are above the average (26%) of airports having mobile website. Asia Pacific is well below average (6%).

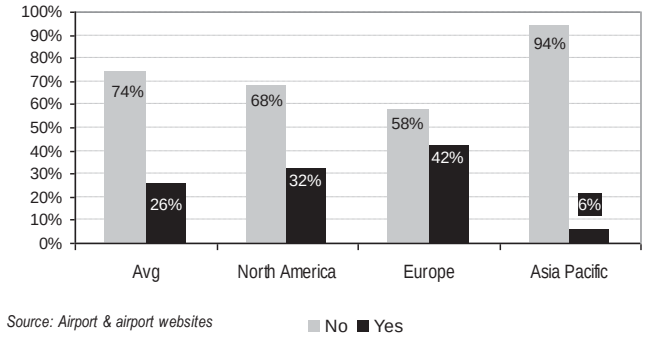

Figure 3-6. Airports with a mobile website by Region

The geographical differences observed seem to be in line with the differences in smartphone adoption. In December 2010 European countries as Spain (38%) and the UK (33%) had higher smartphone penetration than the USA (27%) (comScore, 2011). Asia Pacific, one year earlier had 13% (Boonruang, 2009), thus it is expected than Asia Pacific have a lower level of smartphone penetration than North America and Europe.

As a summary, mobile website penetration was lower in the airports sector than in other sectors of the tourism industry (e.g. airlines); Larger airports are more likely to have a mobile website; and European and US airports are ahead of airports in Asia Pacific when it comes to provide mobile website services.

The three factors evaluated from airport mobile website were: i) Easy Access; ii) Quality of Information; and iii) commercial information.

i. Airport Mobile Ease Access

The evaluation carried out measured how easy was to access the mobile site by passengers using their smartphone. The 64% of mobile websites assessed, forwarded the passenger directly to the mobile website when entering the airport website using a smartphone. This approach seems to be a better

approach in order to save time to passengers when accessing the airport information.

In the other 36% airport of airport mobiles websites, which did not forward the passenger directly to the mobile website, there were two groups: i) Manual easy access: websites with the mobile link very visible at the top-left corner of the screen; and ii) Manual difficult access: websites with the mobile link not easy to find. Example of the second group was Moscow's airport Domodedovo. In the first group of good praxis were the Scandinavian airports Stockholm-Arlanda and Copenhagen.

Mobile websites have normally a reduced amount of content compared with the PC websites. However, sometimes a passenger using a smartphone might want to access information not available in the mobile website. The recommendation of usability experts is: "*For users who need rare features that aren't in the mobile design, you should offer an easy way to switch to the full website*" (Nielsen, 2009). Most mobile websites assessed provided with a link to the full site (e.g. Atlanta or Vancouver airports in Noth America and Frankfurt or Vienna airports in Europe). Only few airport mobile websites did not include this feature (e.g. Paris Airports).

In order to facilitate the access of passenger using smartphones to airport mobile websites, to forward the passenger directly to the mobile website was the most common practice and it is the recommended approach. An alternative to this approach could be to provide a visible link at the top-left corner of the full website. In all cases, as Nielsen (2009) recommends, an easy way to switch between full site and mobile site should be provided.

ii. Airport Mobile Quality of Information for a Departure Passenger

The quality of information was measured by the variety of information available, for a departure passenger going to take a flight, at the airport mobile website. The variables assessed are shown on Figure 3-7 where the overall result indicates that on average 63% of the assessed content information, was included in the mobile websites.

The size of airports did not explain the differences in the information provided (64% vs. 62%). However, the location of the airport seemed to explain some

differences. European airport mobile websites contained an average of 71% of the content compared with 52% in the North American websites. Thus, European airports provide more detailed flight departure information than Americans mobile websites.

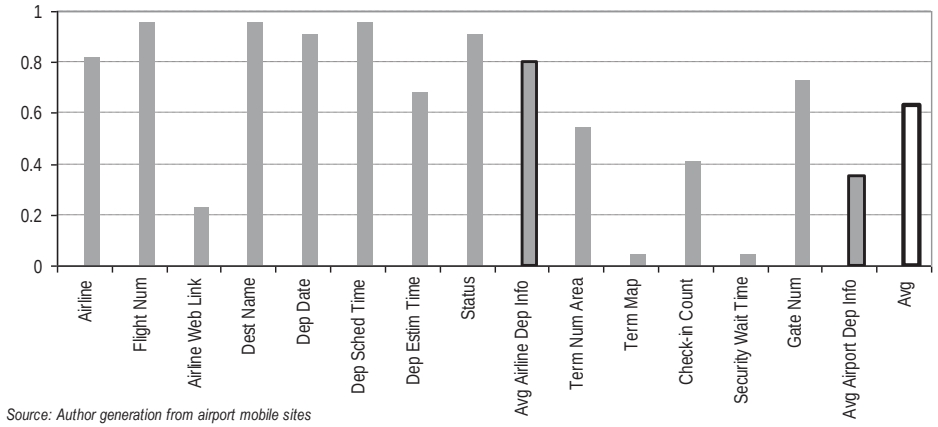

Figure 3-7. Mobile website evaluation: Info quality for a departing flight

Departure information variables were divided into two groups for the analysis: a) Airline information; (e.g. airline name, flight number and destination) and b) Airport information (e.g. Terminal number, terminal map and gate number). At these two groups big differences were observed. The mobile sites assessed included on average 80% of airline vs. 35% airport related information.

Airline information is mostly used to search the flight which helps the passenger to customize the information. Airport related variables refer mostly to physical locations at the airport. The provision of the latter information at airport mobile websites would be relevant to passengers who decide to get assistance from his smartphone while navigating the airport.

The provision of airport terminal relevant information for a departure passenger gives the airport an opportunity to combine it with airport terminal commercial information. For instance, a passenger that checks his boarding gate could easily check, at the same time, the retail services on his way. This possibility was assessed on the next section.

iii. Airport Mobile Commercial Information

Retailing is part of the commercial revenue of an airport and it normally includes restaurants, bars and shops. This information was included in 55% the airport mobile websites evaluated. XL airports were more likely to provide retailing information (64%) than L airports (38%), and looking at region not differences were found at this level.

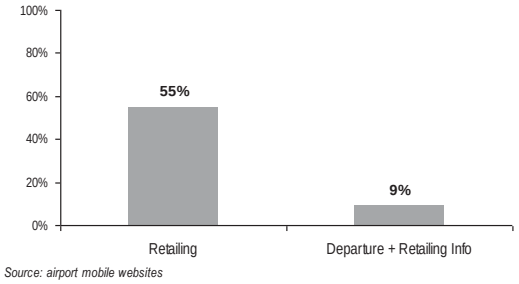

Figure 3-8. Airport mobile retailing information

When evaluating if retailing information was provided at the same time as departure information, only 2 airports were founded (9%). Both airports Fort Worth in Dallas and McCarran in Las Vegas were based in North America and were XL airports.

Although airports have great challenges to develop further commercial revenue (Graham 2009), it seems that the mobile websites is not the main channel they used to promote it at the moment. However, as the number of smartphone users increases, it is expected more demand for airport mobile services and airports will have to improve the services offered, including the commercial offering.

3.4 Limitations

The following limitations should be considered when reading the conclusions.

The sample was extracted from airports around the world and although the airport business is similar across the word, differences can be found between regions and within regions.

The test carried out was with a single smartphone model (iPhone). The performance might be different using other smartphones models. This fact was

evident in Japan, where the evaluation of Narita airport mobile website was not possible as only provide Japanese standard i-mode not viewed by the iPhone.

Only airport mobile websites were analysed in this paper. Some airports provide, in addition (e.g. San Francisco) or as alternative (e.g. Manchester airport), smartphone applications which were not analysed. The analysis of airport mobile applications can be a topic for future research.

3.5 Conclusions

The new airport mobile website services seem to be a good tool for airport operators to help passengers navigating the airport terminals while developing commercial revenues. However, the mobile website evaluation carried out on this paper shows an early stage on the provision of this service by airports.

The actual penetration of airport mobile Internet was of 26% of the largest airports in North America, Europe and Asia Pacific. When looking at geographical location, European and North American airports are more likely to provide this service. The level of adoption by airports was below the levels achieved in other tourism sectors (e.g. airlines or hotels). Thus, the actual level of adoption is expected to increase in the near future.

The access to airport mobile websites was founded to be easy for passengers willing to use the service. However, some efforts will have to be undertaken by the airports in order to keep facilitating the access to passengers. An easy option for users to switch between airport's website full content and mobile websites should always be considered.

The quality of airport departure information provided at airport mobile websites was higher for airline related information (e.g. airline name, flight number, etc.) than for airport related information (e.g. Terminal number, terminal map, gate number). The size of the airports doesn't seem to explain differences on the quality. However, the location of the airport seems to explain some differences: European airports provide the highest quality of information.

Retailing static information is only available at half (55%) of the airport mobile websites evaluated. When looking at dynamic retailing information, combined with departure information, only 9% of the airports are providing it.

3.6 References

ACI. (2009). Top 100 airports worldwide by number of passengers. Retrieved from http://www.aci.aero/

Boonruang, S. (2009, November). Bangkok Post : Android looking to take iPhone's crown. Retrieved February 17, 2011, from http://www.bangkokpost.com/tech/computer/28071/android-looking-to-take-iphone-crown

Chiou, W.-C., Lin, C.-C., & Perng, C. (2010). A strategic framework for website evaluation based on a review of the literature from 1995-2006. Information & Management, 47(5-6), 282–290. http://doi.org/doi: DOI: 10.1016/j.im.2010.06.002

comScore. (2011). The 2010 Mobile Year in Review. Retrieved from http://www.comscore.com/Press_Events/Presentations_Whitepapers/2011/2010_Mobile_Year_in_Review

eyeforTravelResearch. (2009). The School of Mobile: Mobile Technology in Travel (No. volumen 1). Retrieved from http://www.eyefortravel.com/reports

Facebook. (2011). Mobile Internet Users. Retrieved May 25, 2011, from http://www.facebook.com

Lubbe, B. (2007). The effect of Internet apprehension and website satisfaction on air travellers' adoption of an airline's website. Journal of Air Transport Management, 13(2), 75–80.

Manataki, I. E., & Zografos, K. G. (2009). A generic system dynamics based tool for airport terminal performance analysis. Transportation Research Part C: Emerging Technologies, 17(4), 428–443. http://doi.org/doi: DOI: 10.1016/j.trc.2009.02.001

Miniwats. (2011). Internet World Statistics. Retrieved October 15, 2010, from http://www.internetworldstats.com/stats.htm

Nielsen, J. (2009). Mobile Web 2009 = Desktop Web 1998 (Jakob Nielsen's Alertbox). Retrieved February 17, 2011, from http://www.useit.com/alertbox/mobile-2009.html

Orange. (2010). Mobile Exposure 2010. Retrieved from http://exposure2010.orangeadvertisingnetwork.co.uk/pdf/Consumer-Orange-Exposure-English-FINAL.pdf

Park, Y. A., & Gretzel, U. (2007). Success factors for destination marketing web sites: A qualitative meta-analysis. Journal of Travel Research, 46(1), 46.

Ryanair. (2009). Annual Report. Retrieved January 31, 2011, from http://www.ryanair.com/en

Vueling. (2009). Annual Report. Retrieved January 31, 2011, from http://www.vueling.com/

W3C.org. (2011). Usability - ISO 9241 definition. Retrieved February 16, 2011, from http://www.w3.org/2002/Talks/0104-usabilityprocess/slide3-0.html

4 Airport Mobile Internet as an Indication of Innovation

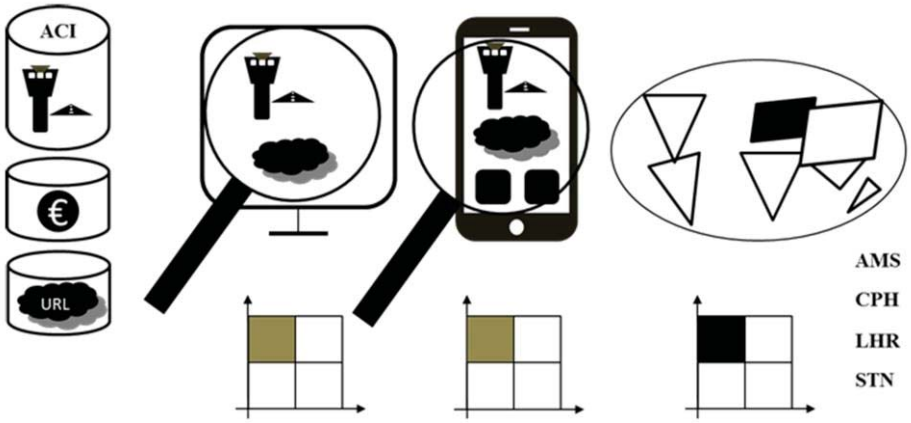

Figure 4-1. Illustration abstract: Airport mobile internet as an indication of innovation

Abstract:

This paper studies the adoption of mobile Internet by airports. Using an innovation theoretical model, the study tests whether airport early adopters of mobile Internet can be considered real innovators. Seventy-five international airports from four different geographical areas and three different sizes are analyzed. The paper complements the analysis including an additional innovation adoption, the PC-website, and both dimensions are analyzed with two different attributes, the time of adoption and the degree of implementation. Our findings show that there are four real innovator airports: London Heathrow, London Stansted, Amsterdam Schiphol and Copenhagen. Airport innovation is not found to be related to airports' size, but it is found to be related to geographical location. Additionally, the unitary commercial revenue per passenger is affected by the time of the innovation adoption.

Keywords: Airport mobile Internet; innovation; PC-website; commercial revenues

4.1 Introduction

Commercial airports have an increasing pressure from both its customer airlines to keep competitive prices and its shareholders to be profitable. One way for airports to please both stakeholders (customer airlines and shareholders) is to develop commercial revenues. However, some factors, such as consumer trends, security developments and political changes, have made it much more challenging for airports to develop commercial revenue (Graham, 2009). To overcome some of these challenges, airports need to innovate by exploring new ways to operate. The use of mobile Internet can be one of those innovations that could help airports to achieve such a goal.

Mobile Internet started to be used in Japan in the late 1990s and gained popularity in the travel information search in the late 2000s (Okazaki & Hirose, 2009). The year 2009 saw some of the first airports adopting mobile Internet services. For instance, during 2009 DFW airport in the USA introduced its first mobile website (DFW, 2009) and Aéroports de Paris in France its first iPhone App (Aéroports de Paris, 2009). Mobile Internet is redefining the market structure in the new economy and the terms e-commerce or e-business is bringing new opportunities to increase revenues and to reduce costs in many industrial and service sectors.

The adoption of mobile services by airports can be considered as an innovation following the definition given by (Orfila-Sintes et al., 2005) as "the conversion of technological knowledge into new services". These new mobile services or applications (Apps) are not only a communication tool that guide passengers from the check-in area to the gate, as they are also used nowadays to customize the passenger experience in different ways that develop new commercial revenues (Munneke, 2014). Kaur (2013) goes even further defining this as a revolution where next generation mobile devices running next-generation mobile Apps will become the major platform to conduct business in any firm and sector. Many different and recent advances in communications, operating systems, software applications, power and hardware are igniting this revolution (p. 36).

Until the introduction of the iPhone by Apple in 2007, the concept of smartphones and its sophistication did not exist. Since then, smartphone users'

growth has increased exponentially, as well as the different existing Apps that have made the access to Internet not only possible but convenient. Airports have benefited from this trend, and in particular e-commerce and m-commerce (commercial transactions that can be made using Internet and/or mobile devices) are areas of future potential expansion. These Apps allow airports to sell some commercial services directly to customers, such as car parking, hotels, rental cars, foreign currency, F&B or other retail shops, executive lounge access or any ancillary activity that is complementary offered at the airport facilities (Halpern & Graham, 2013; Halpern & Regmi, 2013). In any case, as Liébana-Cabanillas, Sánchez-Fernández & Muñoz-Leiva (2014) claimed, the potential use of these Apps can be hampered by the acceptability of the mobile payments which are broadly defined as a system that permits the completion of payments and transactions between two parties in a fast, convenient, safe, and simple way, anytime and anywhere, using a mobile device. In SITA (2014a, 2014b), this issue is highly remarked as 50% of airports surveyed offered flight status notifications and it is expected that this service will be a common practice in the industry by the year 2017. The availability of other services through mobile Apps was still relatively low in comparison, but important efforts are envisaged in the near future as many airports are planning to introduce other notification services such as queue time, customized customer service initiatives that will include sophisticated retail commercial notifications like rebates, personal shoppers, and other marketing campaigns. Looking at the passengers' perspective, mobile boarding passes are the future and the current trend, from check-in desks (33%), from a kiosk (29%) or home-printed (20%), will be marginal practices by the year 2017. This migration to mobile boarding passes will represent an IT revolution for the industry, and it will open the door to further added value additional service that will help airport managers to increase revenues from different ancillary areas.

The aim of this paper is threefold: (1) to propose a theoretical model to analyze the adoption of mobile Internet based on innovation adoption theory; (2) to develop a laboratory experiment to gather and analyze the data; (3) to analyze to what extent early adoption of mobile Internet is a clear sign of airport

innovation and if there exists a positive relationship of this with commercial revenue generation.

The remainder of the paper is organized as follows: Section 4.2 offers some insights from the literature, section 4.3 defines de theoretical model, section 4.4 describes the data used and methodology, section 4.5 presents and discusses the results, and section 4.6 offers some concluding remarks.

4.2 Literature Review

Airports need to innovate in order to develop new sophisticated instruments that generate more commercial revenues. This paper defines and applies a model based on diffusion and adoption of innovation following a theoretical model developed by Rogers (1995).

"An innovation is an idea, practice, or object that is perceived as new by an individual or other unit of adoption" (Rogers, 1995). The unit of adoption in our case is the airport – an organization from the service industry. (Buhalis & Law, 2008) classified the adoption of mobile Internet as a technological innovation and (Orfila-Sintes et al., 2005) defined technological innovation as *"the conversion of technological knowledge into new products, new services or new processes introduced in the market, as well as the significant technological changes in products, services and process".* In this sense, mobile Internet use can be considered a technological innovation in many different areas such as electronic data interchange (EDI), e-information, e-transactions, e-commerce and e-business (Gillen & Lall, 2002). The author distinguished two types of innovations: (i) Marginal in which they simply represent a new way of doing old things better; and (ii) real or true in which they enable and facilitate new ways of doing things that in their absence would not happen.

On one hand, the technological knowledge of airports processing and guiding passengers through the airport terminal building, combined with the technological knowledge of mobile Internet allows airports to provide a new service to the market. Thus, airport mobile Internet can be considered as an innovation. On the other hand, as Halpern & Graham (2013) claimed airport services characteristics have important implications for airport marketing: (i) some service outcomes are determined by staff interaction so it is important to

develop and maintain close relationships with the demand; (ii) it is important to reinforce brand identity and encourage loyalty especially for those airports that experience strong competition; (iii) it is important to invest in quality control that improves the levels of service quality; (iv) it is important to innovate having in mind the future needs of the demand using a marketing mix.

The theory of innovation is normally presented from two perspectives: Diffusion and adoption of innovation. The main difference between both is the level of analysis. Diffusion research mainly focuses on describing and explaining the adoption process as a process of innovation diffusion at the aggregate level (macro level). Adoption research typically studies organization decision to adopt a particular technology or service, at the individual level of analysis - micro level (Pedersen & Ling, 2003). When studying the use of mobile Internet by airports, a typical diffusion research would be to study the adoption pattern of this technology. The adoption theory, however, would study special characteristics of the airports that can be considered early adopters of mobile Internet.

"The rate of adoption of an innovation is the relative speed with which an innovation is adopted by members of a social system" – e.g.. airports (Rogers, 1995). It is also defined as the speed with which the organization adopts innovation after the first introduction elsewhere. The rate of adoption is generally measured as the number of organizations who adopt a new idea in a specific period, for example a year (Rogers, 1995). This measure can also be used at a macro or micro level and it reflects the organization's responsiveness and its ability to adopt innovation quickly relative to its competitors within the industry (F. Damanpour & Gopalakrishnan, 1998) or to other sectors and industries within the economy. Some innovations are adopted much faster than others and the perceived attributes or characteristics of the innovation are intrinsically some of the most important explanations of the rate of adoption of an innovation. Attributes can be used also to compare different innovations (Rogers 1995: 177).

Tornatzky & Klein (1982) carried out a meta-analysis of articles concern with innovation characteristics and their relationship with the innovation adoption and implementation. Three characteristics (*relative advantage, compatibility* and *complexity*) had the most consistence relationships to innovation adoption.

Rogers (1995) founded that between 49 to 87 percent of the variance in the rate of adoption is explained by five attributes that includes the three attributes mentioned above and two other additional attributes like *trialability* and *observability*. (Okazaki, 2006, p. 127) points out that mobile Internet seems to satisfy the five attributes used by Roger.

An organization decision to adopt and implement an innovation does not happen overnight. This process is part of the strategical plan of the firm and it usually consists of different stages: Awareness of innovation, attitude formation, evaluation, decision to adopt, trial implementation and sustained implementation (F. Damanpour & Gopalakrishnan, 1998).

A critic to the innovation diffusion research is that this is often only focused on the dichotomous adoption/non-adoption decision (Frambach & Schillewaert, 2002; Tornatzky & Klein, 1982). The latter suggests that it should focus on both, adoption and implementation of the innovation. The degree of implementation is also called "re-invention" by (Rogers, 1995) because some innovations are not adopted exactly the same as in the origin as they eventually evolve over time.

In this paper, the adoption of mobile Internet by airports is defined as the point in time in which an airport first provides a mobile service to its passengers. The degree of implementation could be measured by the number and the quality of mobile services provided at any point in time, after the innovation was adopted.

4.2.1 Organizational Characteristics and Innovation

The relationship between organizational characteristics of organizations and innovation has been widely studied among organizational innovation researchers (F. Damanpour, 1991). Frambach & Schillewaert (2002) identified three main characteristics that affect the adoption of innovation by organizations: (i) size; (ii) structure; and (iii) innovativeness.

Frambach & Schillewaert (2002) points out that size has repeatedly been found to influence the propensity to be innovation adopters. Lee and Xia (2006) carried out a meta-analysis in order to find out the relation between organization size and IT innovation adoption. The results were that organizational size has a positive effect on IT adoption. Regarding the

structure, the results are not as conclusive as there were different structures that can either facilitate or hamper the innovation adoption. For example, the direction of the association between innovation adoption and organizational operation resources is highly heterogeneous. Some authors found a positive association (Aarons, Hurlburt, & Horwitz, 2010; Fariborz Damanpour & Schneider, 2009; Frambach & Schillewaert, 2002). However, according to other studies, this relationship can also be negative, as well as the lack of a formal research infrastructure (Greenhalgh, Robert, Macfarlane, Bate, & Kyriakidou, 2004; Solomons & Spross, 2011).

Geographical location can be other characteristic that influence on innovation adoption patterns. Kumar et al. (1998) points out that similar diffusion patterns include geographical proximity and cultural or economic similarities. Kim et al. (2004) investigated cross-national differences of the mobile Internet and founded that customers preferred different services in mobile Internet businesses according to the nationalities. Thus, innovation patterns are expected to differ across different geographical locations.

"Innovativeness is the degree to which an organization is relatively earlier in adopting new ideas than other organizations". The adoption of an innovation usually follows a normal bell-shaped curve when plotted over time on a frequency basis. If the cumulative number of adopter is plotted, the result is an S-Shaped curve. (Rogers, 1995)

Rogers (1995) identified five categories of innovators based on the time of adoption as innovators, early adopters, early majority, late majority and laggards.

Business models are usually analyzed focusing on the manner by which the firms deliver value to customers, generate revenues from the customers' willingness to pay, and make profits. It thus reflects how managers analyze what customers want, how they want it, and how the firm can establish all the processes to best meet those needs. This is particularly important in the provision of new products and services associated to the new e-economy in which revenues generation is usually highly constrained because customers expect that these new e-services should be free. In any case, managers need to carefully analyze not only what innovation should be adopted but also what

immediate effects can be expected from the adoption. It is clear that costumers can need a time to adopt the new Internet mobile service, but more difficult can result to obtain an adequate pricing system that can be acceptable to the customer base for its new service. In this sense, the adoption of the innovation with the associated pricing system requires not only understanding the potential alternatives, but also having a good analysis of the costs, customers' willingness to pay, competitors' strategies, regarding their positioning and response (Teece, 2010).

4.3 Theoretical Model

This model aims to find out if early adopters of mobile Internet airports can be considered real innovators. It was defined following the concepts of innovation theory reviewed, together with some hypothesis that will be further explained, considering not only the moment when the innovation was adopted, but also its degree of implementation. Figure 4-2 depicts how the time of adoption is obtained in days for each of the airports included in the sample.

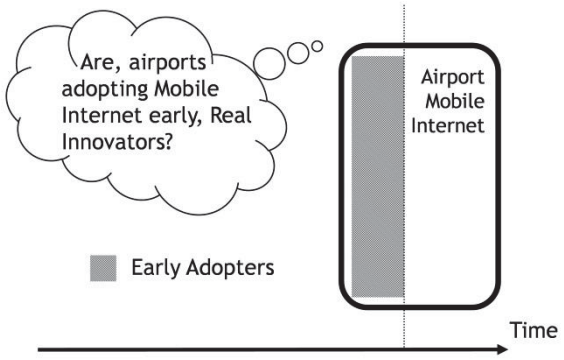

Figure 4-2. Theoretical model: 1 of 4

Rogers (1995) points out that innovation adoption follows a normal bell-shaped curve when all organizations are plotted over time on a frequency basis. This

innovation cannot be tested for normality as not all airports have adopted mobile Internet at the time of research.

Tornatzky et al. (1982) suggest that innovation studies should study the adoption of more than one innovation in order to have more reliable data. Following those suggestions and in order to allow us to test normality on the adoption pattern, this model includes a second innovation. The second innovation was identified by using the five attributes of innovation defined by Rogers (1995) to compare a similar innovation.

The adoption of PC-websites by airports was taken as a past innovation that has been fully adopted. Table 4-1 compares the two innovations using Roger's five attributes. The PC-website service provided by airport was compared to the telephone information services airports provide. The mobile Internet service provided by airports was compared to the services provided at the terminal building to guide passengers throughout the airport.

The comparison of the five attributes Table 4-1 suggests that both innovations can be considered similar. Thus, PC-website service provided by airports is considered appropriate to apply into the theoretical model in order to define innovativeness categories.

Table 4-1. Airport mobile Internet and PC-Internet innovation

	Airport PC-Website	**Airport Mobile Internet**
	Vs. providing telephone services	*Vs. providing airport terminal information panels*
Relative Advantage	Similar services were provided 24 hours a day at a lower cost	Information can be personalized (e.g. gate number)
Compatibility	With airport telephone services	With airport terminal panels
Complexity	Limited as most information and services were already provided	Limited as most information and services were already provided
Trialability	It needs to be provide with a new platform (PC website)	It needs to be provided with a new platform (mobile web or mobile application)
Observability	It is easy to see other airports' adoption	It is easy to see other airports' adoption

Source: Authors' elaboration based on Roger's **(1995)**

The model at this point (see Figure 4-3) includes the PC-website adoption (fully adopted) and the airport mobile Internet adoption (not fully adopted by all airports yet). Both similar innovations are assumed to follow a bell-shaped curve of adoption (Rogers, 1995).

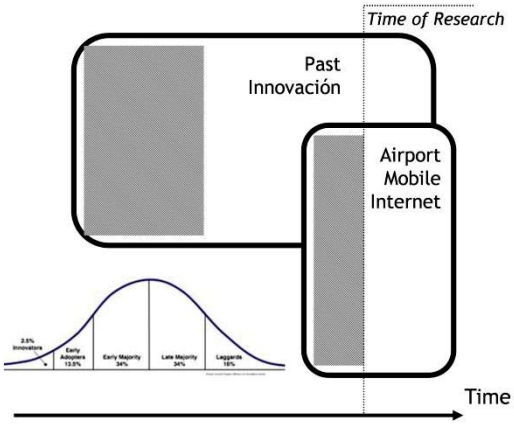

Figure 4-3. Theoretical model: 2 of 4.

4.3.1 Adoption and Implementation of the Innovation

The adoption of mobile Internet is defined as the point in time when an airport starts to provide mobile Internet services. However, the service will evolve over time and change since the first time the service was adopted. For instance, Amsterdam airport Schiphol adopted its iPhone application in March 2011 and in April 2011 released a new version in English in which new functionalities were included such as the possibility of booking car parking directly from the App (Apple.com, 2012). Thus, to measure the innovation of airports by looking only at the time when the mobile Internet was first implemented did not seem to be sufficient (Frambach & Schillewaert, 2002; Tornatzky & Klein, 1982). Thus, the degree of implementation of the innovation to enrich the data reliability is also included in the model.

The model aggregates the first three Rogers (1995) categories, innovator, early adopter, and early majority, into one, named *early adopters,* and the last two categories, later majority and laggards, into one, named *late adopters* (Rogers, 1995). The degree of implementation axis has another two variables: *Low Degree of Implementation* and *High Degree of Implementation*. Low degree includes scores from 0 to 0.49 and High degree includes values from 0.5 to 1.0 (see Figure 4-4).

Innovator is then defined taking into account these two dimensions as the airport which adopts the innovation early and has a high degree of implementation, at the time the analysis takes place. Figure 4-4 shows the area where considered innovator airports will appear when plotting time of adoption and degree of implementation for each airport.

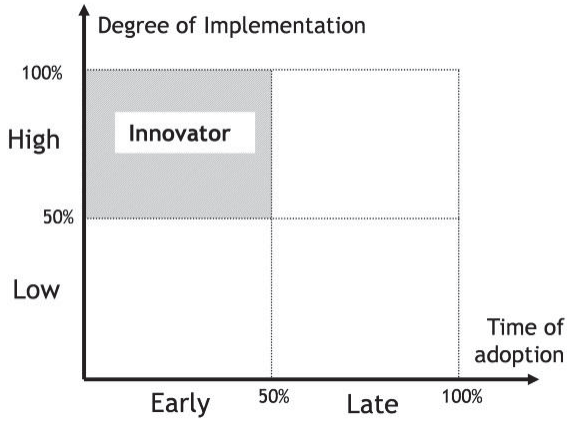

Figure 4-4. Theoretical model: 3 of 4

Following Tornatzky et al. (1982) recommendations of studying more than one innovation, real innovator airports are defined as those that are innovators in the two innovations under study (i.e. the PC-website adoption and the mobile Internet adoption) See Figure 4-5 below.

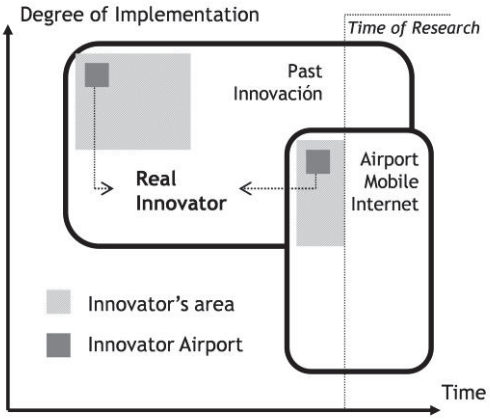

Figure 4-5. Theoretical model: 4 of 4. Real innovator airports

From the group of real innovator airports, it will be possible to analyze some of their characteristics or attributes, which can help us to disentangle some type of association between these variables and innovation. In this paper, the relationship between innovations, proxied by those which are real innovators, and three characteristics of airports based on size, geographical location, and commercial revenues per passenger, will be analyzed.

4.4 Data

The idea was to obtain the data for the research from a laboratory, and one of the self-imposed restrictions was to generate the data minimizing the contact with the airports under study for obvious reasons of costs and time. Thus, the data used for this research can be divided into three parts: airports' general data, airports' PC-website data and airports' mobile Internet data. It was gathered during January and February 2013.

4.4.1 Airports General Data

An airport database with the 145 busiest airports was obtained from the Airports Association Airports Council International (ACI, 2009), in which the total number of passengers in 2009, International passengers, the geographical location of each airport, and the size of the airport were included.

The total revenue and commercial revenue during 2008 was gathered from different sources (Airport annual reports, FAA, ICAO and ACI). Revenue data was founded for 100 airports out of the 145 airports originally selected.

ACI classifies the airports by size as shown on Table 4-2. It was assumed that the provision of information to passengers while passing through the airport terminal was more relevant for larger airports than for smaller airports as walking distances tend to be larger and guidance services at larger airports becomes more relevant.

The target population of airports included commercial airports of more than eight million passengers in 2009 (i.e., "M", "L" and "XL" airports). It was assumed that the provision of information to passengers while passing through the airport terminal was more relevant for larger airports than for smaller airports as walking distances tend to be larger and guidance services at larger airports becomes more relevant.

Table 4-2. Airport categorization by size

Airport Group	Passengers a year [million]	Label
1	> 25	XL
2	10 - 25	L
3	5 - 10	M
4	< 5	S

Source: Authors' own elaboration based on Airport Association ACI

ACI also categorizes airports by geographical location according to the following regions: North America, Latin America-Caribe, Europe, Middle East, Africa and Asia Pacific. The original set of data included airports from all over the world, as it was assumed that the airport business is a global business. In addition, larger airports tend to have a larger number of international airlines and international passengers who will demand similar services at the different airports across the world.

From the original database of 145 airports, a final list of 75 airports was included in the analysis. It included airports from: North America (32), Latin America and Caribe (1), Europe (30), and Asia Pacific (12). In principle, our idea was to include as many airports as possible as since the beginning it was evident that some airports would be eliminated from the sample by lack of data.

4.4.2 Airports PC-Website Data

For each of the airports analyzed, the PC-website data included the following variables: (1) The Internet address (URL); (2) The time when the first website was launched; and (3) the degree of implementation of those websites at the time this research was carried out.

i. Internet Address and Adoption Time

The data source to obtain airports' Internet addresses (URL) was the search engine Google. For each airport, the local Google website was used, -e.g. google.co.uk for airports in the UK. Then, the "name of the city" plus the word "airport" was typed at Google search engine. When the name of the airport was different to the name of the city, the combination of "name of the airport" and

"airport" was also searched. If the name of the airport's official website was still not clear, a third search was carried out at Wikipedia (wikipedia.org). A website was found for each of the airports included in the study.

Time of adoption was measured as the time airports reserved their website domains (e.g., 23 August 1998 for bcia.com.cn - Beijing Capital International Airport). The date when each airport reserved its domain and the date when the first webpage was launched were not expected to be far away. This difference was tested with four airports in Japan where data was available. The longest interval observed was five months for KIX (Kansai airport) launching its PC-website in 1997 and the shortest three days for ITM (Fukuoka airport) launched in 1999. Thus, to take the date when the domain was reserved as the date of adoption of the website seems to be plausible but it would have been advisable to consider the actual time when each airport website was launched. However, whether the results are biased by this simplification could be an interesting line for future research.

The registration date for each airport's website domain was searched using the sources indicated in Table 4-3. The methodology used was to first look for each domain's registration date and the email address of the contact person. If the domain holding the email was different from the airport domain first checked, it was tested as an alternative way to reach the airport's website. In the case that it was an alternative domain to access the airport's website, the registry data was also searched for this second domain. Then, the domain with earlier registry date was taken as the date of adoption.

Table 4-3. Network Information Centers (NIC) for domains

URL	Domains	Notes
www.who.is	.com, .uk, .cn, .kr	
www.whois.ausregistry.com.au	.au	Register date - Not available
www.dns.be	.be	
www.nic.ch	.ch	Register date - Not available
www.denic.de	.de	Register date - Not available
www.nic.es	.es	
www.nic.gr	.gr	
www.domainregistry.ie	.ie	Register date - Not available
www.nic.it	.it	
whois.jprs.jp	.jp	
www.govcert.nl	.nl	Register date - Not available
www.dot.ph	.ph	Register date - Not available
www.nic.ru	.ru	

Source: Authors' own elaboration

Some top level domains, like for example ".de" from Germany, ".au" from Australia or ".gov" from Government in the US, did not provide the registration date. In those cases, an alternative domain was searched. For instance, for Sydney's airport domain (syd.co.au), the alternative domain sydneyairport.com was used. However, this option was not always available as for instance in the case of Düsseldorf airport in Germany (duesseldorf-international.de). For this reason, due to the lack of domain registration date availability, some airports were discarded as mentioned above.

PC-website adoption started in 1995 with 14 airports, reaching the peak of adoption during 1998 with 16 airports. Only three airports adopted websites during 2002, none during 2003 and 2004. The last two adoptions were in 2005 by Huston airports (fly2houston.com).

ii. Degree of Implementation of Airports' PC-Website

The degree of implementation, also called re-invention, occurred as the innovation is modified by users to fit their particular conditions (Rogers, 1995, p. 304). This research aimed to assess airport innovation as a way to analyze how commercial airports are introducing this innovation to develop more commercial revenues. And for this reason, a particular checklist of all the commercial areas developed by the website was considered to measure the degree of implementation of the airport PC-websites.

Table 4-4. Airport PC-website degree of implementation: Variables and weights

Online Booking	Weight	Definition
Shopping	0,25	Book and collect or book and delivery
Parking	0,25	Book parking
Car Rental	0,25	Book car rental or link to their website
Other	0,25	Avg. of the following four variables
Trans to/from	*0,06*	*Book taxi, train or bus*
Flights	*0,06*	*Book flights*
Hotel	*0,06*	*Book hotel or link to hotel website*
Other	*0,06*	*Book currency, VIP lounges, etc.*

Source : Authors' own generation

During 2006, commercial revenue represented 48% of an airport's total revenue and the breakdown of the most important items was: Retail, Parking, Car rental, Property and Advertising (Graham, 2009). Some of those services were also offered at some airport's websites. For instance, retail, parking and car rental. In addition, other ancillary complementary services such as airline tickets and hotels were also available at some airports' websites. When allocating the weight to each group of variables considered in the lab exercise, greater weight (0.75) was placed to the main commercial items mentioned above (shopping, parking and car rental), and more modest weight (0.25) to the other online services (transports, flights, hotels and others). At each subgroup, the same weight was allocated to each variable (i.e. 0.75/3 and 0.25/4). It is evident and clear that this is also an important limitation that our study presents, and a further refinement for these particular weights could be foreseen contacting the airport managers. Thus, individual weights could be obtained for each airport according to the percentage of revenues over the total revenues obtained by the innovation. This is a very interesting and promising area of future research because as it can be seen in (SITA, 2014b), 44 percent of the airports confirmed that the new revenue generation accrued to the innovation fell below expectations.

Each airport website was assessed in order to find out which online services were available. Applying the weight for each variable included in the analysis, the degree of implementation was calculated. The total number of airports included in the sample was seventy five.

4.4.3 Airport Mobile Internet Data

The provision of mobile Internet services by airports analyzed in this paper included two mobile type of platforms: (1) Mobile websites, which are dedicated websites for small screens (Léopold, 2009: 217); and (2) Mobile Applications, which is a special software designed for a specific mobile operating system. Mobile websites are accessed using a web browser; however, mobile applications first have to be installed in the mobile device before they can be used to access the online information. Only applications from iOS (Apple) and Android (Google) were analyzed as they together represent a worldwide penetration of almost 40% (statcounter.com, 2011).

i. Apps and Adoption Time

The sources for airports providing mobile websites were airport websites. The source for iPhone applications was the iPhone application store (Apple.com, 2012), and the source for Android applications was the Android Market – latter called Google Play (android.com, 2012). Each airport website was accessed with an iPhone via its Safari web browser in order to find the airports that provided a mobile website. Airport websites were also accessed with a laptop using the Firefox web browser. To our surprise, out of the 75 airports, only 22 airports (29.3%) were found to provide a mobile website.

The methodology followed to obtain mobile applications was similar to the one used to look for website URLs. First the "name of the city" plus the word "airport" was typed at the iPhone App Store (Apple.com, 2012) and at the Android market (android.com, 2012). When the name of the airport was different to the name of the city, the combination of "name of the airport" and "airport" was also searched. Out of the 75 airports, 17 airports were found to provide an iPhone application and 13 airports to provide an Android application.

The overall number of airports providing mobile Internet, either by one or more mobile platforms was 32 (42.7%). It is expected that sometime in the future all the 75 airports analyzed will adopt mobile Internet. In fact, it is still surprising that, by far, the most common mobile service available is flight status notifications, with only 50 percent of airports offering the service and

this will become a basis service in the industry by 2017. The availability of other services through mobile Apps is relatively low in comparison, but over the next three years more than half of all airports are planning to introduce other mobile services, including queue times, more personalized information, such as opt-in services and customer service initiatives, as well as retail services (SITA, 2014b).

The sources of data for the time of implementation of airport mobile Internet were airports' press releases available at their websites. Airport websites were searched for the news of when their first mobile Internet service was launched. The search was carried out using Google search engine where the words "mobile website", "mobile site" and "mobile application" were typed followed from "site:" and the airport URL.

ii. Degree of Implementation of Airport Mobile Internet

The degree of implementation of an innovation will change as time passes after adoption. Airports have just started to adopt mobile Internet, so the possibility of facilitating the access of passengers willing to use the service was considered important at this early stage. Accessibility has been a common variable used to assess Internet websites, also labeled as easy to use (Y. A. Park & Gretzel, 2007). In this particular case, accessibility was measured on how easy it was to access airport mobile services.

The methodology followed to calculate the degree of implementation was first to look at whether the airports under analysis were providing each of the three platforms (mobile website, iPhone application and Android application). Mobile website was used because it can be accessed from any mobile device with a web browser. iPhone iOS and Android operating systems were chosen as they had a world penetration of 22.1% and 17.6%, respectively (statcounter.com, 2011). The definition and weight of each variable to calculate degree of implementation of airport mobile Internet can be found in Table 4-5.

Mobile Internet can be accessed by any mobile device with a web browser, including iPhone and Android devices. Thus, this variable was weighted with 0.5. However, the accessibility is different depending on the features included.

For instance, a link between the PC-website and the mobile website facilitated the access (Budiu & Nielsen, 2009)

The variable of mobile website was calculated by evaluating four variables defined in Table 4-5. The largest weight was given to the fact of providing a mobile website (0.35) and the other three variables (Auto load, switch to PC and switch to mobile) helped to differentiate the accessibility of those mobile websites and each was weighted with 0.05.

Table 4-5. Airport mobile internet degree of implementation: Variables

Variables	Weight		Definition
Mobile Website	0,5		
Mobile Site		*0,35*	Airport providing dedicated mobile site
Auto Load		*0,05*	Automatically loaded when accessing URL
Switch to PC-Website		*0,05*	Mobile website link to PC-Website
Switch to Mobile		*0,05*	PC-Website link to Mobile website
iPhone Application	0,28		iPhone application provided by airport
Android Application	0,22		Android application provided by airport
TOTAL	1		

Source: Authors' own elaboration

The iPhone and Android operating systems (OS) together represented almost 40% of worldwide penetration. These two OS together had 430,000 Apps at the end of 2010, compared with 43,000 observed at its following competitors, Blackberry and Nokia (Distimo.com, 2011). Thus, it was assumed that these mobile devices will be used more than others and were weighted with 0.5 (i.e. above their worldwide penetration rate of 40%). The world penetration difference between iPhone and Android was taken into account to calculate proportional weights that reflect this observed difference (0.28 vs. 0.22).

The equipment used for the research was a laptop, Internet access with a WiFi router and a smartphone (iPhone 3.0) with WiFi access.

4.5 Analysis and Results

The adoption of mobile Internet by airports was not completed at the time of this research. Thus, the use of a second similar innovation adopted by airports in the past, the PC-website, allowed us to analyze at least one complete

innovation adoption. Time of adoption of PC-website by airports was checked for normality using the Chi-Square goodness-of-fit test.

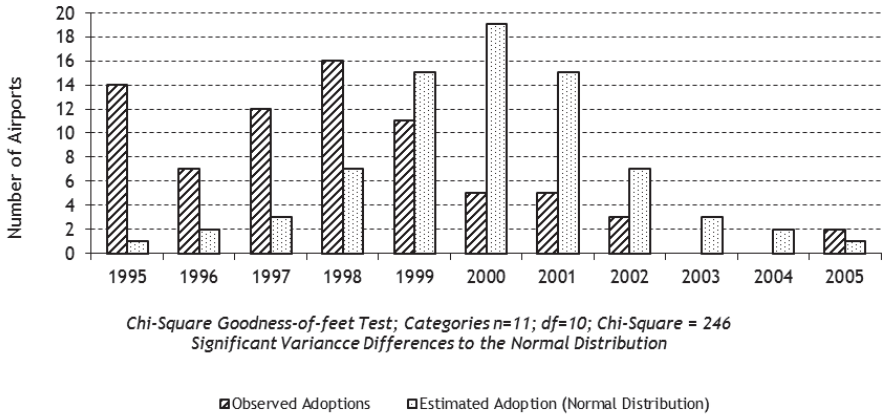

Figure 4-6. Adoption of airport PC-internet: Observed Vs. normal distribution

The calculation of degree of implementation used weighted averages according to the main attributes that characterize both innovations airport websites and mobile platforms. Academic researchers have been using website evaluation methods since the mid 1990s in different fields (Chiou et al., 2010), including the tourism industry (Law et al., 2010).

Scatter plots were used to represent innovator airports at each of the two innovations analyzed. Then, real innovator airports were identified as the airports that are considered innovators for both innovation adoptions (PC-website and mobile Internet).

The relationship or association between the airport characteristics size, geographical location, and unitary commercial revenues per passenger with respect to the innovations are analyzed using different statistical techniques.

Regarding one of the well-known results in innovation studies (Rogers, 1995), we first analyze whether the PC-website innovation followed a normal distribution - a bell-shaped curve. The adoption of PC-website observed and the estimated bell-shaped form was represented in Figure 4-6. In addition, the Chi-Square goodness-of-fit test was calculated. The result showed significant differences with the normal distribution, thus the hypothesis of normality was not supported.

Figure 4-6 showed that important differences appear at the tails of the distribution at the beginning of the distribution, especially during the first year (1995) when the number of airports adopting PC-website was much higher than expected under a bell-shaped normal distribution. There are three reasons that can partially explain the observed deviation: first, the different time delays in activating the websites; second, the fact that PC-website adoption happened simultaneously at different industries and sectors, and it could have an influence on the early adoption; and third, the airport industry is very dynamic and some actors do not lag behind.

Another reason for observing such behavior is the way in which this analysis has been done considering the aggregation by natural years. So, as a way to refine this analysis, it was decided to use the number of days since the first airport adopted the PC-website innovation truncating the airports distribution in an optimal way to obtain the more similar results to a normal distribution. Following this iterative process, it was obtained that the threshold figure in days was 2590 days. In this case, the Shapiro-Wilk normality test allowed us to conclude that the distribution could be considered normal at a significance level of 0.9856. It is out of the scope of the current paper to propose a new categorization of airports based on innovation but the scale proposed by Rogers (1995) could be extended including one additional category as innovators, early adopters, early majority, late majority, laggards and intense-laggards. Laggards, in the diffusion of innovation theory, were considered the minority group (16%) of population, which is the last group to adopt an innovation, but this could be changed if the distribution is not normal in the way we propose here. Figure 4-7 shows that the left tail still presents the most significant deviations with respect to the normal distribution, but in this case the fit was adequate.

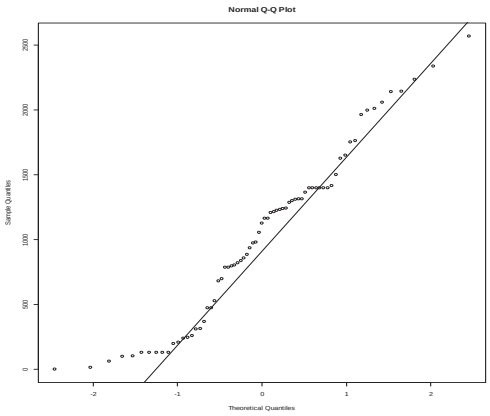

Figure 4-7. Adoption in days of airport PC-Internet: Observed Vs. normal Q-Q plot

Many of the innovation adoption processes researched in the past responded to a normal distribution as they were isolated processes adopted by individuals (Rogers, 1995). However, PC-websites were not only being adopted by airports, but also by many other industries (Law et al., 2010). Thus, the decision for airports to adopt PC-websites could be affected, not only by other airports, but also by other industries and sectors adopting this type of innovation.

4.5.1 Real Innovator Airports

The main objective of the research was to find out if early adopter airports of mobile Internet could be considered innovators. The theoretical model indicated that not only the adoption time was sufficient to measure innovation, and for this reason it was decided to include also the degree of implementation of each of the type of innovations.

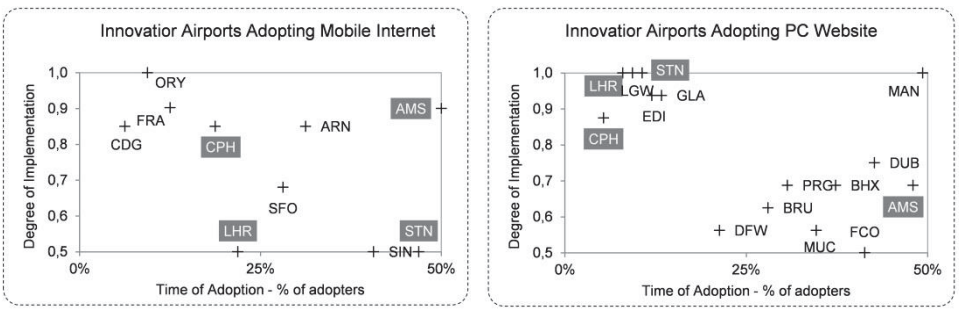

Figure 4-8. Innovator airports: Adoption and degree of implementation

The scatter plots in Figure 4-8 showed, for both type of innovations under analysis, the innovator airports. PC-website adoption included 15 airports (20%) and mobile Internet adoption included 10 airports (13.3%). These percentages of adopters were similar to the percentage of adopters that was obtained by Rogers (1995), including the first two categories (i.e. a total of 16% - innovators with 2.5% and early adopters with 13.5%).

The model used the term "real innovator" for those airports which were found to be innovators in both innovations under study. Four airports (Amsterdam Schiphol - AMS, Copenhagen – CPH, London Heathrow – LHR and London Stansted – STN) fell under the category of real innovators and represented 5.3% of the total number of airports analyzed. This percentage result was again not far from the 2.5% of innovators obtained by Rogers (1995).

The results showed that, to our surprise, these two innovations, that apparently should be really related, are introduced by airports very differently. It can be seen that only four airports, considered the real innovators, are in both sets, meanwhile other 17 airports have preferred to focus the innovation on one singular process, either PC-website or mobile Internet. It is interesting to remark that results could be affected by the fact that the degree of implementation has also been taken into account. In a less formal analysis, considering only time adoption and a binary variable to indicate whether the airport has adopted or not the innovation, the results could be very different.

4.5.2 Characteristics of Innovator Airports

It seems that size and geographical area might influence the time of adoption or the degree of implementation achieved by the PC-website innovation. For this reason, one-way analysis of variance is going to be used in order to examine whether there are significant differences that can be accrued to these particular factors. Table 4-6 shows the standard ANOVA table, which divides the variability of the PC-website innovation into two parts: variability due to the differences among the factor groups means (variability between groups); and variability due to the differences between the individual airport observation in each group and the group mean (variability within groups).

The results of the ANOVA show that the null hypothesis, i.e., the average PC-website innovation adoption by the airports is equal, independently of the geographical area location or size of the airport, may be rejected in some cases. The p-value, shown in the sixth column, casts doubt on the null hypothesis and suggests that at least the innovation depends to some extent on the geographical area in which airports are located. However, the size does not have any effect on this type of innovation. This result is in line with the existing controversy about the real relationship between innovation and firms' size, in which the results seem not to be conclusive (Frambach & Schillewaert, 2002).

However, regarding the geographical area, it can be observed that as we accept the alternative hypothesis and this is too general, more precise information could be obtained regarding which pairs of means are significantly different, and which are not. For this reason, we study pair wise mean differences to assess in what sense a group of airports can be characterized by being more or less innovative.

To do this, we need to use some multiple comparison procedure. In our case, we use the Tukey-Kramer test in order to determine the representative groups that are significantly different according to the geographical location and each of the innovation variables under study, name list the adoption time and the degree of implementation. As we want to compare every group to each other, we can form six different pairwise comparisons to obtain their mean differences attending their geographical area. Differences and 95% confidence interval for these differences were obtained, but for the ease of exposition only the main observed differences are discussed. Regarding the adoption time, the following result was obtained: (1) North-American airports are more early adopters than East-Asian Pacific airports. With respect to the degree of implementation, the results were even more accuses as it could have been anticipated by the ANOVA results. In particular, the following results were obtained: (1) European airports develop more sophisticated PC-websites than the rest of the airports as the three comparisons with the rest of the geographical regions presented a significant difference.

Table 4-6. One-way analysis of variance. PC-website innovation

Days	Df	SumSq	MeanSq	Fvalue	Pr(>F)	
Size	2	1107175	553588	0.82	0.444	
Residuals	72	48580322	674727			
Geographical Area	3	4264728	14221576	2.222	0.093	.
Residuals	71	45422769	639757			
Grand mean: 1139.33						
Degree of implementation						
Size	2	0.04	0.01979	0.261	0.77	
Residuals	72	5.456	0.075			
Geographical Area	3	1.52	0.50	9.08	3.6 E-05	***
Residuals	71	3.97	0.05			
Grand mean: 0.3775						
Signif. codes: 0 `***' 0.001 `**' 0.01 `*' 0.05 `.' 0.1 ` ' 1						

Size factor means

	M	L	XL	
Days	1048 (13)	1301 (27)	1048 (35)	
Degree of Implementation	0.40 (13)	0.39 (27)	0.35 (35)	

Geographical area factor means

	East Asia & Pacific	Europe	Latin America & Caribbean	North America
Days	1609 (12)	1090 (30)	2011 (1)	982 (32)
Degree of Implementation	0.31 (12)	0.54 (30)	0 (1)	0.25 (32)

Source: Own elaboration.
(*) The number of airports appears between the parentheses for each of the factor means.

These results are consistent with the left part of the Figure 4-8 as it can be seen that most of the airports included in this figure are located in Europe except Dallas/Fort Worth International airport (DFW) in North America. The four airports (London Heathrow, London Stansted, Amsterdam Schiphol and Copenhagen), identified as real innovators, were all in Europe and were located within a triangle with the longest distance of 981 Km. Thus, we can conclude that the geographical location of airports is an airport characteristic that helps to explain innovation.

To end the analysis, a classification and regression tree CART model is going to be used to obtain some insights of the importance and the effects of the PC-website innovation on the generation of commercial revenues. CART analysis is an appropriate methodology for analyzing whether the unitary commercial revenues per passenger is affected by the innovation measured by the two dimensions analyzed in the research, the time of adoption and the degree of implementation.

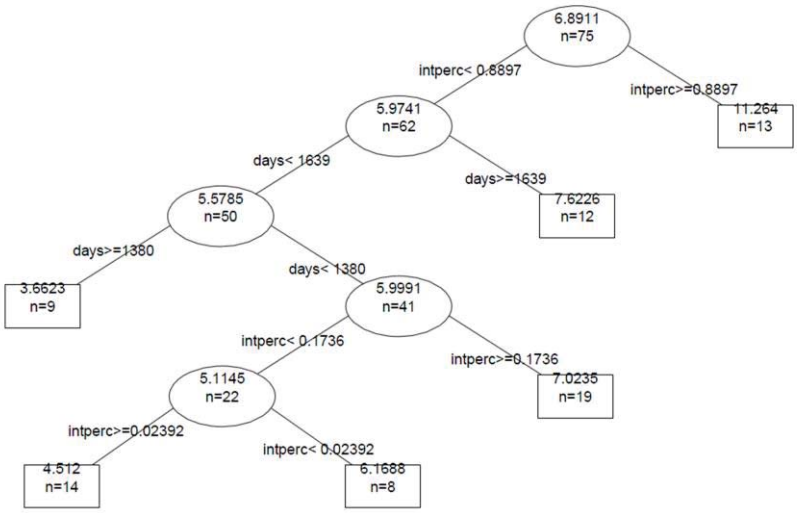

Figure 4-9. Unitary revenues per passenger. CART plot

CARTs have a number of benefits compared to other widely used parametric models. The main advantage of the CART model is that plots show the basic information of the analysis in a very intuitive way. Figure 4-9 represents the results in a sort of a framework of ‘‘If-then’’ rules. Moreover, the CART analysis allows the researchers to use a large set of explanatory variables to be processed and the most important variables are easy to find as those that are included in the final structure of the tree. In this case, variables of different nature were used, some of which were continuous such as the percentage of international passengers, the degree of implementation of the PC-website innovation, and the time of adoption, and other were categorical or factor variables, like the size and the geographical area of the airports.

Another advantage of the CART analysis is that it does not need to specify a functional form or any other assumption about the variables included in the analysis. In other econometric models, results can be biased if the model is erroneously specified or any assumption about the variables included or the error terms are violated, as for example error invariance or multicollinearity problems.

Figure 4-9 shows that the unitary revenues per passenger depends very much on the type of traffic that the airport services. As a general observation, it can be seen that there are only two variables out of the five included that affect the unitary commercial revenues, name list the percentage of international passengers and the time of adoption of the innovation. The other variables were not included in the final model. In particular, it can be seen that there seems to be a positive trend between the percentage of international passengers and the unitary commercial revenues. It can be seen that the tree represents an increase of unitary revenues from left to right, and that in the majority of the occasion the international participation is also ordered in the expected way except in the down part of the tree. In fact, this part is affected by those airports that have been more innovative as it can be seen in the node containing 50 airports with average unitary revenue of 5.6 USD per passenger, in which it is clear that the innovation increases the unitary revenues per passenger. In this case, the airports should include the PC-website before 1380 days. However, the results are not so conclusive in the upper part of the branches in which another threshold figure is observed on 1639 days. There were 12 airports that present more unitary revenues in spite of postponing the innovation adoption. Of course, CART was obtained with the observed units and it is very difficult to conjecture what would have happened in these airports had been more innovative as other tree would have been obtained. To our purpose, this model is very appealing as only the identification of important effects is needed, and other techniques could be used in the future to obtain more casual modelization.

4.6 Conclusions and Final Remarks

The analysis of airports regarding the early adoption of mobile Internet is still in its infancy, and at the time of the experimental lab of this research, the degree of penetration of this innovation was still very limited. However, as Information, Telecommunications and Technology budgets at airports are increasing annually, and the appearance of new technology such as geo-location, near field communication, ibeacons and other, this field needs to be studied and analyzed as in the near future when the passengers will turn digital and mobile Apps will be basic services. Airports are still at the very early

stages of leveraging all the potential use of the websites and the mobile devices. As in Gillen and Lall (2002), the first initiative airports can take is to improve their websites.

In this research, we first provide a theoretical model to establish the framework used to analyze what was defined as airports that can be considered real innovators. In our case, this is based on two complementary innovations, the PC-website and the mobile Internet. These two innovations were analyzed through two different dimensions: the adoption time and the degree of implementation.

The database was compiled through the application of an experimental lab that did not only take into account the date in which the innovation was launched but also the degree of implementation with the help of the characteristics of both, the PC-website and the mobile Internet. Following the assumptions included in the experimental lab regarding the selection of proper weights and a prior list of the 145 busiest airports in terms of passengers, the final database consisted of 75 international airports covering very unevenly four geographical areas and three different size types. The main reasons for dropping airports from the sample were the inexistent of revenue data and date when the airport PC website or mobile Internet services were launched.

Real innovators were defined according to the eight quadrants analyzed using both innovation processes and the four quadrants created with the help of the performance for each of the dimensions. Finally, we showed the existence of four airports that were considered real innovators: Amsterdam Schiphol (AMS), Copenhagen (CPH), London Heathrow (LHR) and London Stansted (STN).

Analyzing the pattern of the distribution of the adopted time for the PC-website innovation, it was shown that the pattern of innovation adoption did not follow a bell-shaped curve or a normal distribution. For this reason, restricting the database to the best perfect scenario in which the distribution was normal, an extension of the categories for the diffusion of innovation was obtained in which 4 airports out of 75 were considered intense-laggards.

Three airports' characteristics were analyzed, size, geographical area, and the unitary commercial revenue per passenger. For the first two characteristics,

models based on ANOVA were applied to conclude that size did not explain innovation, but the geographical area appeared to be related to innovation. European airports were found to develop more characteristics in the PC websites and mobile Internet services than the rest of the airports. The third characteristic, the unitary commercial revenue per passenger, is affected by the time of the innovation adoption.

There are at least two limitations in this research. First, the sample only includes very busy airports (i.e. medium, large and very large airports). Mobile Internet seems to be more relevant for larger airports, but the inclusion of smaller airports will better test if the size of airports can explain airport innovativeness. Second, it was only possible to analyze three airport characteristics (size, geographical region, and unitary commercial revenue per passenger) in order to explain innovation. These are other potential variables that can be analyzed in the future like for example airport networks, importance of low-cost carriers (LCCs), governance, percentage of IT&T budget over total, marketing staff, and R+D staff are other potential variables that could be also analyzed with the intention of getting more thoughtful insights. In particular, airport competition can be highly affected when vertically differentiated products may be strategically conjointly offered at the time of the purchase through the Internet including some additional commercial product like car parking, car rental, hotel reservation, F&B, or exchange money to the core product which is based on the embarkment and disembarkment (Bracaglia, D′Alfonso, & Nastasi, 2014).

Finally, another interesting topic for future research is the analysis of the complementarities of the airports' innovation with all the agents involved in tourism and travel, especially for those destinations that depend very much on air transport, like for example airports in islands. Some guidelines could be obtained from the synergies extracted from the travel and tourism industry in conjunction with the social media, especially Facebook and Twitter. Reservations and payments for restaurants and attractions is a topic that will deserve attention in the case of tourist airports. Airports make little use of Facebook to communicate marketing campaigns to passengers, and the number of posts is still very low but according to Wattanacharoensil & Schuckert

(2015), more attention should be given to this aspect of airport communication. So, this issue could also be used to analyze a third innovation process.

4.7 References

Aarons, G. A., Hurlburt, M., & Horwitz, S. M. (2010). Advancing a Conceptual Model of Evidence-Based Practice Implementation in Public Service Sectors. Administration and Policy in Mental Health and Mental Health Services Research, 38(1), 4–23. http://doi.org/10.1007/s10488-010-0327-7

ACI. (2009). Top 100 airports worldwide by number of passengers. Retrieved from http://www.aci.aero/

Aéroports de Paris. (2009). My Airport –Official Aéroports de Paris service. Retrieved June 30, 2014, from https://itunes.apple.com/gb/app/my-airport-the-official-aeroports/id322543617?mt=8

android.com. (2012). Apps - Android Market. Retrieved February 2, 2012, from https://market.android.com/

Apple.com. (2012). Apple - iPhone - Application Store - App Store. Retrieved February 6, 2012, from http://www.apple.com/iphone/apps-for-iphone/

Bracaglia, V., D'Alfonso, T., & Nastasi, A. (2014). Competition between multiproduct airports. Economics of Transportation, 3(4), 270–281. http://doi.org/10.1016/j.ecotra.2015.02.004

Budiu, R., & Nielsen, J. (2009). Usability of Mobile Websites: Research Report with Design Guidelines. Retrieved from http://www.nngroup.com/reports/mobile/

Buhalis, D., & Law, R. (2008). Progress in information technology and tourism management: 20 years on and 10 years after the Internet–The state of eTourism research. Tourism Management, 29(4), 609–623.

Chiou, W.-C., Lin, C.-C., & Perng, C. (2010). A strategic framework for website evaluation based on a review of the literature from 1995-2006. Information & Management, 47(5-6), 282–290. http://doi.org/doi: DOI: 10.1016/j.im.2010.06.002

Damanpour, F. (1991). Organizational innovation: A meta-analysis of effects of determinants and moderators. The Academy of Management Journal, 34(3), 555–590.

Damanpour, F., & Gopalakrishnan, S. (1998). Theories of organizational structure and innovation adoption: the role of environmental change. Journal of Engineering and Technology Management, 15(1), 1–24. http://doi.org/10.1016/S0923-4748(97)00029-5

Damanpour, F., & Schneider, M. (2009). Characteristics of Innovation and Innovation Adoption in Public Organizations: Assessing the Role of Managers. Journal of Public Administration Research and Theory, 19(3), 495–522. http://doi.org/10.1093/jopart/mun021

DFW. (2009). DFW International Airport Debuts Mobile Web Site. Retrieved September 8, 2014, from http://www.dfwairport.com/pressroom/Debuts_Mobile_Web_Site.pdf

Distimo.com. (2011). Total Number of Smartphone Applications. Retrieved June 11, 2011, from http://www.distimo.com/blog/2011_01_distimo-releases-full-year-2010-report/

Frambach, R. T., & Schillewaert, N. (2002). Organizational innovation adoption: a multi-level framework of determinants and opportunities for future research. Journal of Business Research, 55(2), 163–176. http://doi.org/doi: DOI: 10.1016/S0148-2963(00)00152-1

Gillen, D., & Lall, A. (2002). The economics of the Internet, the new economy and opportunities for airports. Journal of Air Transport Management, 8(1), 49–62. http://doi.org/doi: DOI: 10.1016/S0969-6997(01)00041-2

Graham, A. (2009). How important are commercial revenues to today's airports? Journal of Air Transport Management, 15(3), 106–111. http://doi.org/doi: DOI: 10.1016/j.jairtraman.2008.11.004

Greenhalgh, T., Robert, G., Macfarlane, F., Bate, P., & Kyriakidou, O. (2004). Diffusion of Innovations in Service Organizations: Systematic Review and Recommendations. The Milbank Quarterly, 82(4), 581–629. http://doi.org/10.1111/j.0887-378X.2004.00325.x

Halpern, N., & Graham, A. (2013). Airport marketing. New York: Routledge. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&scope=site&db=nlebk&db=nlabk&AN=601494

Halpern, N., & Regmi, U. K. (2013). Content analysis of European airport websites. Journal of Air Transport Management, 26, 8–13. http://doi.org/10.1016/j.jairtraman.2012.08.006

Kaur, S. (2013). The Revolution of Tablet Computers and Apps: A Look At Emerging Trends. IEEE Consumer Electronics Magazine, 2(1), 36–41. http://doi.org/10.1109/MCE.2012.2223371

Kim, J., Lee, I., Lee, Y., Choi, B., Hong, S. J., Tam, K., … Maeda, Y. (2004). Exploring e-business implications of the mobile internet: a cross-national survey in Hong Kong, Japan and Korea. International Journal of Mobile Communications, 2(1), 1–21.

Kumar, V., Ganesh, J., & Echambadi, R. (1998). Cross-National Diffusion Research: What Do We Know and How Certain Are We? Journal of Product Innovation Management, 15(3), 255–268.

Law, R., Qi, S., & Buhalis, D. (2010). Progress in tourism management: A review of website evaluation in tourism research. Tourism Management, 31(3), 297–313.

Lee, G., & Xia, W. (2006). Organizational size and IT innovation adoption: A meta-analysis. Information & Management, 43(8), 975–985.

Léopold, E. (2009). The future of mobile check-in. Journal of Airport Management, 3(3), 215–222.

Liébana-Cabanillas, F., Sánchez-Fernández, J., & Muñoz-Leiva, F. (2014). The moderating effect of experience in the adoption of mobile payment tools in Virtual Social Networks: The m-Payment Acceptance Model in Virtual Social Networks (MPAM-VSN). International

Journal of Information Management, 34(2), 151–166. http://doi.org/10.1016/j.ijinfomgt.2013.12.006

Munneke, M. (2014). The Moodie Report´s e-Zine - The airport app of the future (No. 138) (pp. 28–29). Retrieved from http://edition.pagesuite-professional.co.uk/Launch.aspx?EID=3fe80105-f49b-439a-966a-4661567eb368

Okazaki, S. (2006). What do we know about mobile Internet adopters? A cluster analysis. Information & Management, 43(2), 127–141. http://doi.org/doi: DOI: 10.1016/j.im.2005.05.001

Okazaki, S., & Hirose, M. (2009). Does gender affect media choice in travel information search? On the use of mobile Internet. Tourism Management, 30(6), 794–804. http://doi.org/doi: DOI: 10.1016/j.tourman.2008.12.012

Orfila-Sintes, F., Crespo-Cladera, R., & Martinez-Ros, E. (2005). Innovation activity in the hotel industry: Evidence from Balearic Islands. Tourism Management, 26(6), 851–865. http://doi.org/doi: DOI: 10.1016/j.tourman.2004.05.005

Park, Y. A., & Gretzel, U. (2007). Success factors for destination marketing web sites: A qualitative meta-analysis. Journal of Travel Research, 46(1), 46.

Pedersen, P. E., & Ling, R. (2003). Modifying adoption research for mobile Internet service adoption: Cross-disciplinary interactions. In Proceding 36th Hawaii International Conference on System Sciences.

Rogers, E. M. (1995). Diffusion of innovations. The Free Press.

SITA. (2014a). Airport IT Trends Survey 2014. Retrieved from http://www.sita.aero/surveys-reports/industry-surveys-reports/airport-it-trends-survey-2014

SITA. (2014b). The passenger IT Trends Survey 2014 | SITA.aero. Retrieved from http://www.sita.aero/resources/type/surveys-reports/passenger-it-trends-survey-2014

Solomons, N. M., & Spross, J. A. (2011). Evidence-based practice barriers and facilitators from a continuous quality improvement perspective: an integrative review. Journal of Nursing Management, 19(1), 109–120. http://doi.org/10.1111/j.1365-2834.2010.01144.x

statcounter.com. (2011). Top 8 Mobile Operating Systems in Apr 2011. Retrieved June 7, 2011, from http://gs.statcounter.com/#mobile_os-ww-monthly-201005-201105

Tornatzky, L. G., & Klein, K. J. (1982). Innovation characteristics and innovation adoption-implementation: A meta-analysis of findings. IEEE Transactions on Engineering Management, 29(1), 28–45.

Wattanacharoensil, W., & Schuckert, M. (2015). How Global Airports Engage Social Media Users: A Study of Facebook use and its Role in Stakeholder Communication. Journal of Travel & Tourism Marketing, 32(6), 656–676. http://doi.org/10.1080/10548408.2014.955245

5 Airport Surface Access and Mobile Apps

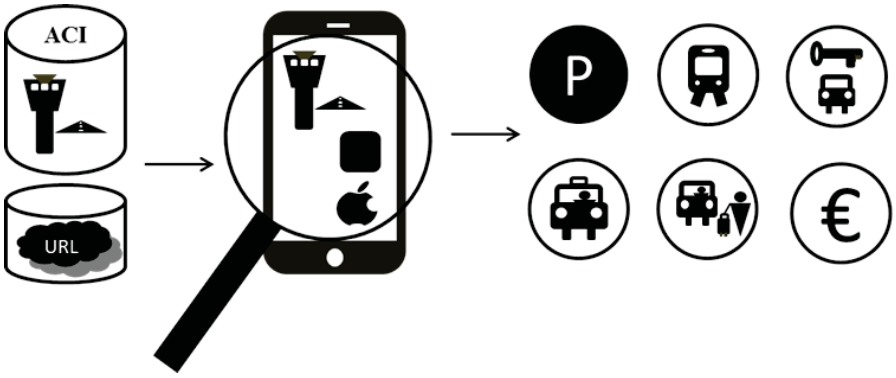

Figure 5-1. Illustration abstract: Airport surface access and mobile Apps

Abstract

Purpose: Airport surface access faces two main opposite issues: (1) cars, being the main transport mode, contribute to the increasing level of congestion and pollution of cities; and (2) simultaneously, parking fees are one important source of airports commercial revenue, creating a dilemma for airports when facing the problem. Following the recent trend of air passengers travelling with smartphone (78% in 2013), the purpose of this paper is to monitor the adoption of mobile applications (Apps) by airports and to analyze if the information and functions provided in those Apps can help to overcome the above two issues.

Design/methodology/approach: 31 iPhone App of some of the largest European airports were evaluated in the lab using the evaluation model of destinations mobile applications (Scolari & Fernández-Cavia, 2014) adapted for the airport surface access on airport Apps.

Findings and Originality/value: The Apps evaluated provided a very limited functionality to help passengers to plan and book their trips to/from the airports on public transports and gave high priority to parking information and services.

Originality/value: Although Airport surface access has been a widely researched, the originality of this paper is the analysis of airport mobile Apps as a potential tool for airports to deal with the surface airport access problems.

Keywords: Access, airports, mobile Internet, commercial revenues

5.1 Introduction

Airport surface access refers to the journey legs of transferring to and from the airport. The previous research on this topic has clearly identified two main opposite issues: (1) cars, being the main transport mode, contribute to the increasing level of congestion and pollution of cities; and (2) simultaneously, parking fees are one important source of airports commercial revenue, creating a dilemma for airports when facing the problem.

The demand for air passengers, with a 5% average growth rate, was doubled during the last 15 years and it is expected to double again in the next 15 years (Airbus 2013). Thus, airports will need to keep adapting their capacity to the new demand, including the Airport Surface Access. This affects passengers, employees and visitors (Budd et al., 2011), but the scope of this paper is mainly on passengers. The Airport surface access includes different transport modes. Those could differ from airport to airport. One classification used by Budd, Ryley and Ison (2014) is: Car and Park, Drop-off/Pick-up, Taxi and Public Transport.

Car Park refers to passengers driving and parking at the airport. Drop-off/Pick-up refers to passengers taken by someone by car to/from the airport. Sometimes also called “kiss and fly” (Marsden, Kamal, & Muir, 2006). Public transportation normally includes bus, rail and shared vans (Coogan, 2008).

The level of pollution of each transport mode was estimated by Miyoshi and Mason (2013) for Manchester airport. They are shown below and can be easily applied to other airports as they use grams of CO2 emissions per passengers kilometer.

Figure 5-2. CO2 emissions on airport surface access grams per passenger kilometer [g./ pKm]. (Miyoshi & Mason, 2013)

Drop-off and taxi access options generate higher levels of emissions because they generate two airport rides for each passenger or group of passengers (Miyoshi & Mason, 2013), compared for instance with passengers parking their cars at the airport, which generate only one. Car Park, Drop-off and taxi are sometimes aggregated in a single group of passengers travelling by private cars (Budd et al., 2011).

Private cars are the main airport access mode. For instance, it is estimated that for major European airports 65% of passengers use private cars to access the airport (Budd et al. 2011). In the US, the percentage was over 80% in 2005 (Coogan, 2008).

Private cars, especially passengers driving to the airport, use the airport parking and contribute to an important source or airport commercial revenue (Budd et al., 2011). For instance, parking fees contributed to 31% of the total commercial revenue at US airports during 2006 and 18% worldwide. Total airport commercial revenue represented 48% of the total revenue in 2006 (Graham, 2009). This figure seems to be stable as the same figure of 48% was published again by ACI (2012) for 2011.

The management of these Airport surface access can be tackled from different perspectives; Budd et al. (2011) grouped the different instruments into four categories

- *Public Infrastructure and Policy:* Facilitating airport access and promoting public transport
- *Airport Management Strategies:* Promoting the use of public transport
- *Technology:* Access information and green transport technology
- *Airport Parking Policy:* Increasing value added parking service and development of revenue

Three technology innovations were evaluated by (Ryley et al., 2013) with the aim to reduce the number of trips by private cars (especially drop-off and pick-up) and to increase the use of public transport: Telepresence to reduce relatives to drop-off / pick-up passenger; RIDF (radio-frequency identification to have control of the luggage while using public transport and software to increase ride-sharing. The results suggest that consumers need to have a better understanding of technological innovations.

Although there is abundant bibliography about the airport surface access issue, there is a limited research on this topic and the use of technology. The use of smartphone technology with respect to Airport surface access is a area of research and highly relevant in recent years, as shown in the figure below, the penetration of smartphones of air passengers has increased very rapidly reaching 78% of passengers in 2013 (SITA, 2013).

Figure 5-3. Smartphone penetration for air passengers (SITA, 2013)

The purpose of this paper is to monitor the adoption of mobile applications (Apps) by airports and to analyze if the information and functions provided in those Apps can help to overcome the two main airport surface access issues: (1) To reduce the use of cars by promoting and facilitating the use of public transport; and (2) To generate commercial revenue from airport access from other sources different than parking fees.

5.2 Methodology

The steps and methodology followed to collect the data for this paper were the following:

5.2.1 Airport Database

Data: Database of the 100 largest worldwide airports by number of passengers

Type: Secondary data

Date: 2010

Source: ACI - Airports Council International

Method: Contacting ACI and requesting the database

5.2.2 Airport Mobile Internet Adoption

Data: Airport mobile website and applications adoption

Type: Primary data

Date: Feb - Mar 2014

Source: Author

Method: Searching for each airport mobile website and Android and iPhone applications (same as on chapter 4). There were several mobile platforms on the market, but only the Android and iPhone platforms were evaluated as they represented more than 90% of market share (IDC, 2014).

5.2.3 Airport Surface Access Info on Airport iPhone Apps

Data: Evaluation of 31 European airport's iPhone Apps on airport surface access

Type: Primary data

Date: Jun 2014

Source: Author

Method: Selecting airports from one region – Europe in order to have a more homogeneous sample as airport access might differ considerably with other world regions (e.g. North America).

Only the iPhone App was evaluated as this option provided public information through the Apple store that was not available for the other options (e.g. Implementation date).

Adapting an evaluation model of Scolari and Fernández-Cavia (2014) to the airport surface access on airport Apps.

Downloading the 31 airport App onto an iPhone 5 used for evaluation

Evaluating each App on the items described in the next section

5.3 Results

This section summarizes: (1) the overall Internet mobile adoption by the sample of some of the 100 largest worldwide airports; (2) A general evaluation

of 31 European airports iPhone's applications; and (3) the airport surface access content and functions of those 31 Apps.

5.3.1 The Airports Mobile Services for Smartphones

Following the rapid adoption of smartphone by passengers mentioned in the introduction section, airports have been quickly implemented mobile websites and applications. The Airport mobile Internet adoption chart below shows the increase from 2012 to 2014. For instance, 29% of the airports had adopted mobile website in 2012 compared to 69% two years later.

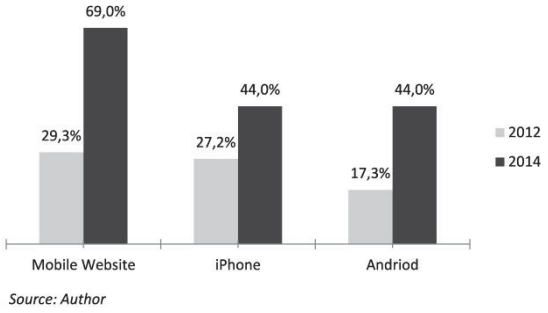

Figure 5-4. Airport mobile Internet adoption

The levels of adoption were different for each type of platform (e.g. mobile website vs. application) and across the different geographical regions. The chart below "Airport mobile adoption by region" shows those differences.

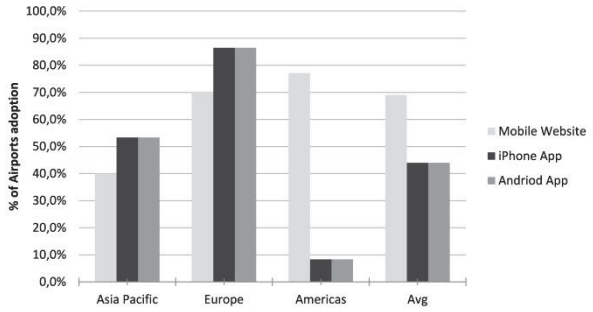

Figure 5-5. Airport mobile adoption by region

The mobile websites were more popular in the Americas (77%) and the Apps were more popular by European airports (86.5%) followed by Asian airports (53.3%).

5.3.2 General Description of the iPhone Applications

This section includes a general description of the 31 European airports' iPhone applications evaluated.

i. Time when the App was Adopted

The first iPhone device was launched in 2007 and the App store one year later in 2008. After that, developers could create their own applications and users could download Apps (many of them for free). In June 2014 there were 1.2 million Apps in the App store (Perez, 2014). From the surveyed airports, Paris airports were the first airports of the sample launching the iPhone App in July 2009. This means that Paris airports have been providing the App during 5 years.

When looking at all the airports surveyed, they have been providing the iPhone App for an average of 2.6 years. This can be considered a short time, thus mobile services provided by airports are expected to be further developed in the future. For instance, in the case of Paris airports, which now provides the App in 10 different languages, most of the languages were included in the service four years after the first launch in 2009 (Aéroports de Paris, 2013).

ii. Business Model

All the applications were provided for free. Therefore, mobile Apps themselves are not used as a direct source of revenue by airports. Airports seem to provide these Apps to improve the passenger experience and to develop other commercial revenues (e.g. car parking).

iii. Business Production

The main developer and "seller" of the surveyed airport Apps was the airport company. It is difficult to know and anticipate whether airports have or not used external companies to develop the App, however airports remind as the main owner and can be considered the official airport App. This can be relevant to differentiate them from some other airport Apps provided by third parties and where airports did not have control.

iv. Languages

The language is an important issue in tourism applications (Scolari & Fernández-Cavia, 2014). This is also an important element for airports, where a large percentage of passengers at large airports travel from other countries.

English is the official language in aviation and airports provide physical signage in English as well as in the local languages - when different than English. The below chart: "Languages available on the iPhone Apps" shows that most of the airport provided local language and English (97% and 94%). However, the number of airports providing other languages was low (26%). A good practice among those airports was Paris Airport, who provides the App in ten different languages.

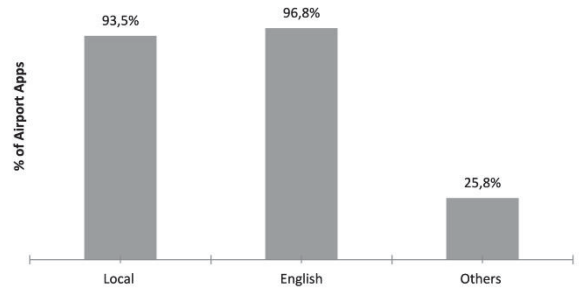

Figure 5-6. Languages availble on the iPhone Apps

v. Link between Website and the App Store

One easy way for users to find the right airport App quickly is to have a link between the airport website and the App store, from where the App can be downloaded. This facilitates the search of the airport mobile App because when going directly to the application store, it is not always clear what the official App of the airport is. 74% of airports were founded to provide a link from the website to the App store.

vi. Quality of the App

One criteria followed to measure the quality of the App was to measure how often the App was updated. In order to keep improving the quality of the Apps, some airports implement the recommendations given by passengers. For

instance, Heathrow Airport (2014) when releasing the updated version of the App the 3rd of July 2014 mentioned:

> *"We have listened to some of your feedback and made the following enhancements to improve your experience: ... Display the flight status ahead of the gate; Resolve an issue with the Airport Guide… Please keep posting your comments – it really helps Heathrow to make every journey better"*

It is assumed that those Apps that have more often updated provide a better quality. Evaluated Apps averaged 4.7 updates a year. In general, it is observed that after the first release of the App, an extra fine tuning is usually needed and more updates are carried out during the first months. For instance, Spanish Airports App had 9 updates during the first nine months.

5.3.3 Content of the Applications

This section includes the content of airport surface access of the App evaluated

i. Transport Modes available on the App

The chart below "Modes shown on the App" shows the airport surface access modes included on the 31 Apps evaluated. It can be seen that 100% included parking information, 90% Public Transport, 80% Taxi, 77% Rent-a-car and just 13% dedicated specific information for drop-off and pick-up services.

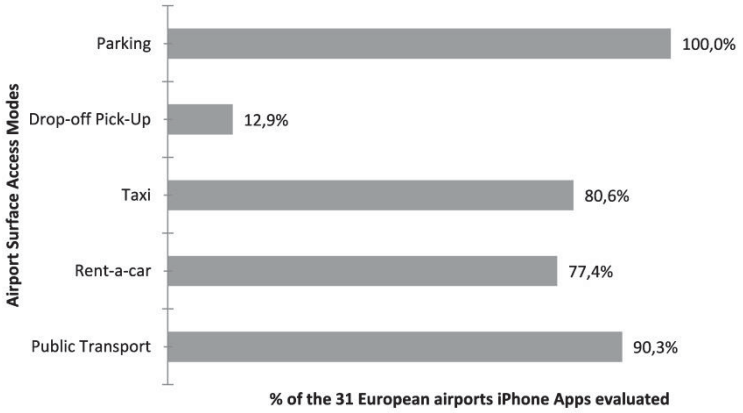

Figure 5-7. Transpot modes shown on the Apps

ii. App Sections on Airport Surface Access

On airport access, three main areas were identified on airport Apps: Parking, ground transport and services. 27 airports (87%) had a separated section for parking and only 4 airports (13%) included parking under ground transportation.

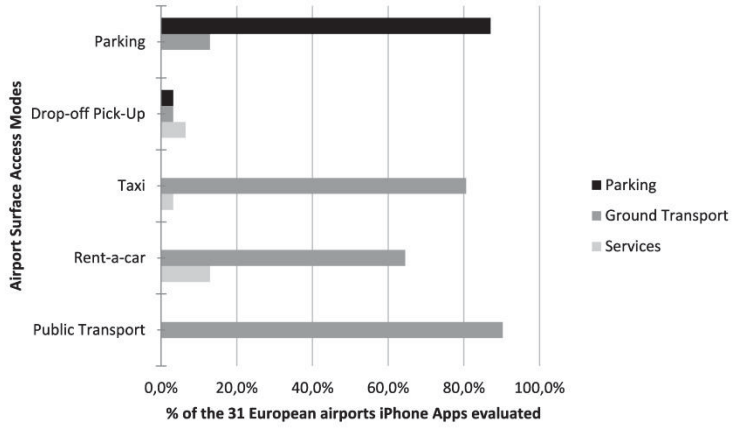

Figure 5-8. Sections where access mode is placed on the App

The ground transportation section was used for most of the airports for information about taxis (80%), rent-a-car (65%) and public transport (90%).

The third category of services was used for information about taxis by 4 airports (13%)

Having these three sections, airports did seem to follow the recommendation given by Coogan (2008): "Airport access information systems should integrate all modes of transport".

iii. Clicks away from the App's Home - Importance

One way to measure the importance given to each airport access from the airport on the App is by measuring the number of clicks away from the App's home.

The below chart "Clicks away from home App – priority" shows parking is given the highest priority with 68% of the airports providing the parking section at the home of its App. By contrast, public transport was only provided by 10% of the airports at the App's home.

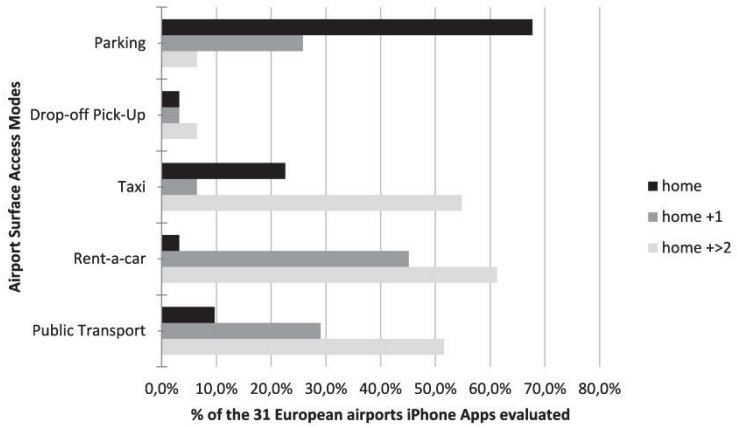

Figure 5-9. Clicks away from home App (i.e. Priority)

5.3.4 Functions of the Apps

This section includes the functions identified on the mobile App related to airport surface: Booking functionality, travel planner, real time info, weather and maps.

i. Booking Functionality

Regarding booking Coogan (2008) suggests that "airport access information systems should provide for immediate ticket sales". Airports did not seem to follow this suggestion as the chart below shows how this functionality was only implemented as a common feature in the case of parking, with 68% of the sampled airports providing this option on their Apps. For the rest of the transport modes or services it is practically inexistent.

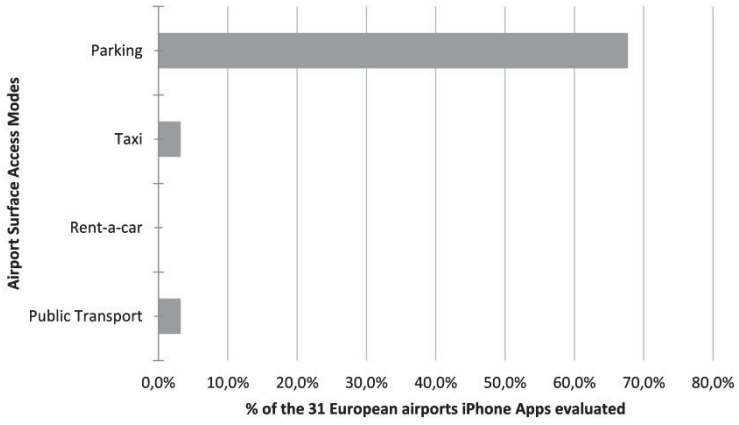

Figure 5-10. Booking functionality

ii. Travel Planner

For passengers who don't know the way to the airport or the airport access modes of transport a travel planner can help the access to and from the airport. 20% of airports provided with a travel planner to drive to and from the airport. In the case of those passengers wishing to use public transport 29% of the airports provided them with a travel planner. For the small number of airports providing travel planner, Google was often the used solution (e.g. Heathrow airport).

Figure 5-11. Travel planner availability

iii. Real Time Info

Providing real time information on the road (e.g. traffic conditions) or on the public transports (e.g. when is the next train departing) to passengers can help passengers to choose the most optimal transport modes. The situation can change depending on the travel day or time of the day (e.g. traffic conditions). Therefore, real time information is an important attribute when passengers plan their access in order to help them with their choices. The chart below on "Real time info available on the App" shows that only 10% of airports provided real time info about the roads to/from the airport and 20% real time information on public transport.

Figure 5-12. Real time info available on the App

iv. Weather

The weather conditions of the date of travel could also influence the transport mode chosen by passengers. For instance, during a rainy day, a passenger might want to avoid long walking distance to public transport stops and decide to take a taxi. Rain often increases levels of road congestion and some passenger might choose a rail alternative that is usually considered more reliable in these circumstances. Thus, weather information can be a useful piece of information to decide the best alternative of access to/from the airport. The chart below "Airports showing the weather on the App" shows that only 42% of airports provided this information. This percentage is considered to be very low, taking into account that airports could easily provide this information with some weather forecast provider.

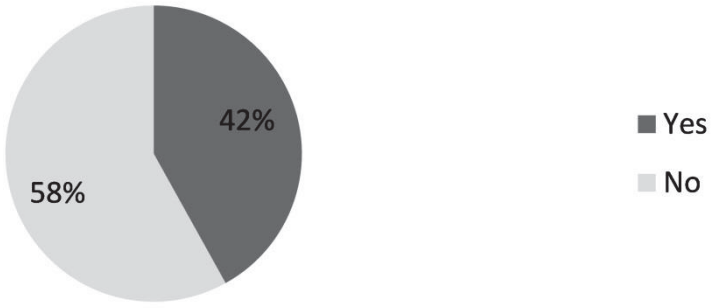

Figure 5-13. Airports showing the weather on the App

v. Maps

Maps can help passengers to orientate themselves at the airport as well as to situate the airport in relation to the city for those not familiar with the city. The chart below "maps included on the Apps" shows that most of the airports

(90%) provided maps of the airport, but only 30% of airports provided maps to help passengers to locate the airport within the city.

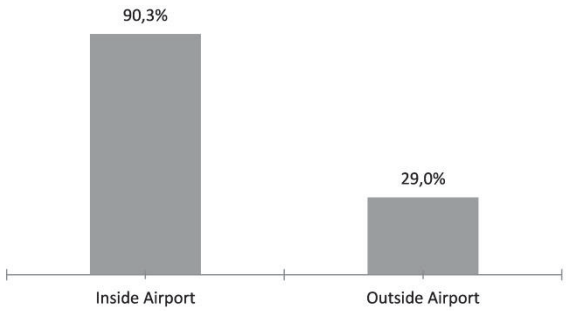

Figure 5-14. Aiports including maps on the App

5.4 Discussion

Airport worldwide are reacting to the quick adoption of smartphones by air passengers with mobile websites and mobile Apps. The fastest adopter region is Europe where almost 90% of large airports provide mobile Apps.

After a close evaluation of 31 European airport Apps we have learned that Airports have been providing Apps during an average of 2.6 years for free, so the application itself is not taken as a source of revenue. Airports make it reasonably easy for passengers to download those applications as a large number provide a link on the airport website to facilitate the download of the App. English and the local language of the airport, when different than English, are almost always available on the Apps, however only 25% of airports provided other languages. Airports have taken seriously the quality of the Apps because they release on average more than four new versions of their Apps every year.

The airport surface access information is always included in the airport Apps. The main transport modes or services included are: Parking, public transport, taxi and rent-a-car. Parking seems to be given more importance as it is normally shown on a dedicated section on the home screen of the Apps, compared for instance with public transport which is normally some clicks away from the home of the App. Overall, the airport access information is still mostly static information.

When evaluating the booking options related to airport access we see that almost only parking can be booked directly from the Apps. So airports keep relying on parking fees as the main source of commercial revenue from the different airport surface access modes. Only few exceptions, such as Amsterdam Schiphol with the taxi or Vienna with the airport train, allow passengers to book directly from the App. The implementation of the booking to different transport modes from their Apps could facilitate the shift of more passengers to public transport. At the same time, airports could explore other sources of commercial revenues different from parking exploring some commercial agreements with the respective stakeholders and managers.

Other functionality that could help and empower passengers to decide on the airport access mode are: Travel planner, real time info of traffic conditions and public transport, and weather information. However, the evaluation carried out shows that there is still a very limited functionality provided by airports in this respect.

5.5 Conclusions

The generalization in the use of smartphones by passengers and the provision of mobile applications by airports is a recent trend.

Airport surface access information is included in those applications. However there is still a limited airport access functionality to help passengers to plan and book their trips tickets to/from the airports.

The reduction of congestion and pollution around airports could come by increasing the number of passengers using public transport. However, these airport Apps have at the moment a very limited focus on public transport.

Parking has a high priority on those Apps and seems to be the main focus for commercial revenue from airport surface access. Airports have not explored yet the development of other sources of commercial revenue while promoting public transport.

5.6 References

Aéroports de Paris. (2013). My Airport –Official Aéroports de Paris Service. Retrieved May 24, 2014, from https://itunes.apple.com/gb/app/my-airport-the-official-aeroports/id322543617?mt=8

Budd, T., Ison, S., & Ryley, T. (2011). Airport surface access in the UK: A management perspective. Research in Transportation Business & Management, 1(1), 109–117.

Budd, T., Ryley, T., & Ison, S. (2014). Airport ground access and private car use: a segmentation analysis. Journal of Transport Geography, 36, 106–115. http://doi.org/10.1016/j.jtrangeo.2014.03.012

Coogan, M. A. (2008). Ground access to major airports by public transportation (Vol. 4). Transportation Research Board. Retrieved from http://www.google.com/books?hl=en&lr=&id=VD3HXwzpz5IC&oi=fnd&pg=PA1&dq=Coogan,+M.+(2008).+Ground+access+to+major+airports+by+public+transportation,+ACRP+(Airport+Cooperative+Research+Programme)+Report,+4,+Washington,+D.C:+Transportation+Research+Board+of+the+National+Academies.&ots=gHnRHDCyk2&sig=drL5TEGPonvWDIKBEaAdapWuzG4

Graham, A. (2009). How important are commercial revenues to today's airports? Journal of Air Transport Management, 15(3), 106–111. http://doi.org/doi: DOI: 10.1016/j.jairtraman.2008.11.004

Heathrow Airport. (2014). Heathrow Airport Guide. Retrieved July 3, 2014, from https://itunes.apple.com/gb/app/heathrow-airport-guide/id427951859?mt=8

IDC. (2014). Smartphone OS Market Share. Retrieved June 1, 2014, from http://www.idc.com/prodserv/smartphone-os-market-share.jsp

Marsden, G. R., Kamal, P., & Muir, H. (2006). Kiss and Fly-a study of the impacts at a UK regional airport. Retrieved from http://eprints.whiterose.ac.uk/42630/

Miyoshi, C., & Mason, K. J. (2013). The damage cost of carbon dioxide emissions produced by passengers on airport surface access: the case of Manchester Airport. Journal of Transport Geography, 28, 137–143. http://doi.org/10.1016/j.jtrangeo.2012.12.003

Perez, S. (2014). iTunes App Store Now Has 1.2 Million Apps, Has Seen 75 Billion Downloads To Date. Retrieved June 30, 2014, from http://techcrunch.com/2014/06/02/itunes-app-store-now-has-1-2-million-apps-has-seen-75-billion-downloads-to-date/

Ryley, T., Elmirghani, J., Budd, T., Miyoshi, C., Mason, K., Moxon, R., … Zanni, A. (2013). Sustainable Development and Airport Surface Access: The Role of Technological Innovation and Behavioral Change. Sustainability, 5(4), 1617–1631.

Scolari, C. A., & Fernández-Cavia, J. (2014). Mobile Applications and Destination Branding in Spain. International Journal of Interactive Mobile Technologies (iJIM). Retrieved from http://online-journals.org/index.php/i-jim/article/view/3575

SITA. (2013). Passenger IT Trends Survey 2013 | SITA.aero. Retrieved from http://www.sita.aero/surveys-reports/industry-surveys-reports/passenger-it-trends-survey-2013

6 Airport Service Quality using Fuzzy Numbers and TOPSIS

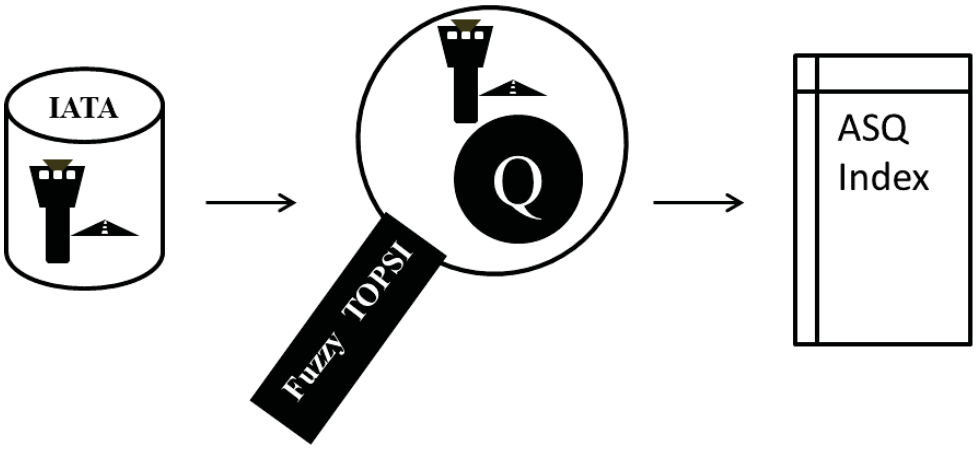

Figure 6-1. Illustration abstract: Airport service quality using fuzzy numbers and TOPSIS

Abstract

Airports have experienced profound structural changes such as commercialization, privatization and globalization, together with an increase competition among airports. For this reasons, airports are now more customer service oriented than in the past and airport service quality is receiving more attention. This paper presents a fuzzy logic approach in order to solve a multidimensional problem that evaluates the airport service quality. The theory of fuzzy sets is used by applying triangular fuzzy numbers (TFN) as a method to overcome some language problems, i.e., the ambiguity of the concepts that are associated with subjective judgments when measuring the service quality with linguistic terms. Based on the concept of the degree of optimality, via the TOPSIS method, a synthetic ASQ index is developed for a sample of fifty seven hub airports using information of twenty four different attributes. The SQ elasticity coefficients are calculated for a group of best and worst SQ airports and for all the attributes. Our results allow airport managers to identify the different dimensions which can be object of improvement that could produce better ASQ gains.

Keywords: Airport Service quality, Fuzzy Logic, Triangular fuzzy numbers, TOPSIS

6.1 . Introduction

The seventy percent of world's GDP in 2013 is generated by the service industry (World Bank, 2013) and the air transport is an important player with a contribution of 3.4 percent. It plays a crucial role in other industries as for instance tourism, where more than fifty percent of international tourism travels by air to reach their final destinations. The total number of air passengers in 2014 were more than 3 billion (half of the world's total population) using near 4000 airports in every corner of the world (ATAG, 2014).

Airports do not only need to adapt their capacity to cope with the estimated 4.7 percent increase in passenger growth for the next 20 years (Airbus, 2014), but they also need to take into account the new trends on passengers' preferences in order to provide an adequate service quality to them. Airport service quality is relevant for many different reasons. According to Graham (2013) airports have been encouraged to place more emphasis on quality as a consequence of profound structural changes observed in the industry, such as commercialization, privatization, and globalization, together with an increased competition between airports.

Airport service quality (ASQ) is also a good indicator for the tourist industry and the image of a particular destination, as the first contact of the tourists usually starts at the airport (Fernandes & Pacheco, 2008; Rendeiro Martín-Cejas, 2006). In the case of hub airports, ASQ is more related to the efficiency of those airport operations involved in facilitating the connection to the passengers. Park and Jung, in a research at Seoul Incheon airport, founded that "*airport service quality raise the level of transfer passengers' satisfaction, value perceptions, and airport image formation"* (2011, p. 75). Airports are an important part of the value chain as Oum, Yu, & Fu (2003) contended because all air carriers seek to expand their operations in efficiently operating airports in order to reduce their costs and increase the quality of the services provided to the passengers. Thus, ASQ can be considered an important driver to provide a competitive advantage for airports and those airlines that adjust the flight waves in order to facilitate connections (Kuo & Liang, 2011; Lupo, 2015).

The evaluation of airport performance and quality has gained attention by both, airport managers and researchers, using two different perspectives: (1)

Economic and operational; and (2) Service Quality. For example, there are two well-known approaches that can be cited here. First, on the economic and operational performance, the Air Transport Research Society publishes the Global Airport Benchmarking Report since the year 2001 (ATRS, 2014). With respect to the service quality dimension, Airport Council International organizes the ASQ Awards since the year 2006 (ACI, 2014). The literature on airport performance has grown exponentially since the publication of the Global Airport Benchmarking Report (Merkert & Assaf, 2015; Oum et al., 2003). The ASQ literature is well covered on the literature review.

Research on ASQ has become a common practice irrespectively of which airlines or passengers are using the airport facilities (Graham, 2013). Lupo (2015) summarizes the evaluation on ASQ into three categories: (1) Stated Importance Methods (SIM)**,** where passengers are directly asked to rate perceptions and expectations on linguistic-numerical Likert type scales; (2) Derived Importance Methods (DIM)**,** where expectations of service aspects are statistically derived considering relationship among performance according to service criteria, sub-criteria and items, on one hand, with overall passenger satisfaction on the other; and (3) Multi-Criteria Decision-Making (MCDM) that are based on utility theory for evaluating and/or selecting service alternatives such as AHP, TOPSIS, VIKOR, etc. In some cases, the analysis also takes into account fuzzy extension of passengers' vagueness, imprecision and subjectivity in service quality dimensions.

Until now, there has been very little research analyzing ASQ. Fodness & Murray (2007) conducted an empirical survey of passengers' expectations and found that ASQ could be defined as a three dimensional construct conformed by interaction, function and diversion. The interaction dimension is usually analyzed taking into account labor encounters in areas such as, check-in, security process, gate access, etc. The functional area usually includes those tangible variables related to airport facilities like seats, signs, screens for information, baggage trolleys, luggage conveyors, etc. And finally, diversion is usually conformed by food and beverage retailers, other commercial stores, decoration, business centers, etc. Fernandes & Pacheco (2008) analyzed ASQ using a complex set of 36 quality dimensions that includes these three dimensions in a different order. Lubbe, Douglas, & Zambellis (2011) applied

the model developed by Fodness & Murray (2007) at the O.R. Tambo International Airport (South Africa), and found that different segments, business and leisure passengers, have different preferences. Other recent papers have adapted the classical dimensions of the Servqual methodology to ASQ and airlines service quality (tangibles, responsiveness, reliability, assurance and empathy), for example (Chou et al., 2011; Erdil and Yıldız, 2011; Liou et al., 2011). Han et al. (2012) examined the influence of service quality on overall satisfaction and revisit intentions to airline lounges and discovered that the quality of F&B was the strongest predictor of satisfaction and revisit intentions.

The aim of this paper is to obtain a synthetic ASQ indicator using fuzzy numbers and TOPSIS. Our study is based on the 1999 IATA Global Airport monitor database which has 42517 respondents for 57 airports located in four different regions: Europe, Middle East, Asia and North America. The method will be outlined taking into account twenty-four different dimensions analyzed in the IATA surveys. The elasticity of each dimension of ASQ will also be analyzed for a particular group of airports to explore which dimensions are more or less important in the overall satisfaction experienced by the passengers. The analysis can be considered a valid tool for the airport's managers in order to distinguish which areas needed attention from those that were currently well managed. This paper contributes to the current strand of the literature on ASQ which is still scarce.

6.2 Literature Review

This section is based on a narrow search that could contribute to a better understanding of the object of the study, ASQ. ASQ papers were founded by using the following three words: "airport", "quality" and "service" on the title field. The search was extended to Airport Level of Service (LOS) by using the Keywords "airport", "service" and "level".

Airport LOS research started in the 1980s by bringing into the airport business the experiences on highway and pedestrian planning (Ashford, 1988). Müller and Goslin (1991) started to evaluate the level of service for airport using qualitative ratings given by passengers at San Francisco airport and converting

them into quantitative measures. This line of research has been developed using the regression analysis method to find the relationship between passenger responses and operational indicators as for instance waiting time (Correia & Wirasinghe, 2004, 2007, 2010; Correia, Wirasinghe, & de Barros, 2008). While airport LOS research combines subjective data collected from passengers and objective data, ASQ mainly concentrates on the first.

The ASQ line of research started in early 2000s and the research pace increased from 2010. Asia appears to be the most researched world region on ASQ (see Table 1). At the same time, Asian airports are the most awarded airports in terms of quality awards – In 2014 eighteen Asian airports (out of 20) of more than 5 million passengers ranked the highest ASQ scores (ACI, 2015b). When looking at the number of airports included in the studies, except few exceptions, most papers evaluated the quality of one airport.

Table 6-1. ASQ research papers reviewed

Num	Author	Year	Region	Territory	Num_Airports
[2]	(Bezerra & Gomes, 2015)	2015	S.America	BR	1
[1]	(Lupo, 2015)	2015	Europe	IT	3
[7]	(Merkert & Assaf, 2015)	2015	Word	World	30
[17]	(Bogicevic et al. 2013)	2013	Word	N/A	N/A
[5]	(Ibrahim, 2011)	2011	Africa	TN	3
[3]	(Kuo & Liang, 2011)	2011	Asia	CN, JP, KR, TW	7
[4]	(Liou et al., 2011)	2011	Asia	TW	1
[9]	(Lubbe et al., 2011)	2011	Africa	SA	1
[14]	(Park & Jung, 2011)	2011	Asia	KR	1
[13]	(Tam, Lam, & Lo, 2011)	2011	Asia	HK	1
[10]	(Tsai, Hsu, & Chou, 2011)	2011	Asia	TW	1
[12]	(Tam, Lam, & Lo, 2010)	2010	Asia	HK	1
[15]	(Chou, 2009)	2009	Asia	TW	2
[6]	(Fernandes & Pacheco, 2008)	2008	S.America	BR	6
[16]	(Fodness & Murray, 2007)	2007	N. America	US	N/A
[8]	(Rendeiro Martín-Cejas, 2006)	2006	Europe	ES	1
[11]	(Sohail & Al-Gahtani, 2005)	2005	M. East	SA	1
[18]	(Janic, 2003)	2003	Word	N/A	N/A

Source: Authors' own elaboration by searching papers containing the three key words 'airport' 'service' 'quality' on the title .

Within ASQ evaluations, regardless of the method applied, first thing to do is to bring the concept of global quality through a set of attributes or dimensions of service. Just to look at three well-known relevant cases, it can be said that ACI (2000) identified 217 subjective service attributes and 52 objective ones, IATA[19] (2000) evaluated a small number of airports using 24 ASQ attributes, and finally BAA (2002) is an airport group that has been carrying out a continuous passenger satisfaction survey for many years and its quality of survey monitor (QSM) is based on a sample of over 60,000 passengers for the UK airports that measures 26 service attributes for departure process, 15 attributes for arrival process and 6 common attributes for departure and arrival. Objective attributes are usually measured in minutes for example check-in waiting time.

Once the selection of attributes has been accomplished, the quality assessment normally starts with a survey to passengers who have recently experienced the airport facilities including some socio-economic variables that can also be of interests for researchers. Regarding the SQ attributes, each respondent has to score all the experienced dimensions on an n point Likert scale[20] (e.g. 1: poor; n: excellent). It is important for the survey that passengers could answer not experienced or not available to those particular dimensions that have not been used by travelers. For example, some passengers could have made the check-in

[19] IATA's Global Airport Monitor series were at that time one of the most popular references on ASQ, as many national and international media cite the ranks of major international airports. Thanks to its popularity in media, airport authorities around the world were very concerned about the result of evaluation, and thus they were keen to implement SQ improvement programs. Nevertheless, some airports considered that the sample size was too small, and as a result, IATA Global Airport Monitor was replaced by the AETRA customer satisfaction survey in 2004, which was later replaced by the Airport Service Quality survey administered by ACI. Unfortunately, the full results of ACI's ASQ survey are only available to participants.

[20] The Likert scales that have been more profusely used are based on 5 and 7 points.

online, so they will not have good or accurate information about the check-in services provided by the airport. In some cases, the validity of the questionnaire could be jeopardized if travelers cannot answer with realism.

The number of attributes used, varies among the different ASQ literature reviewed. Martín-Cejas (2006) uses only one attribute (waiting time at check-in time), while Fernandes & Pacheco (2008), at the superior observation uses 35 attributes. Fifty percent of the reviewed papers use more than 20 attributes.

The attributes identified on the reviewed papers come from different sources (see Figure 6-2). "Literature Review" is the main source of attributes (56%), follow it by attributes defined or adapted by the "Author" (33%). Practitioners (17%) is mostly composed by airport managers and Award Programs (17%) includes the ASQ Awards (ACI, 2014) and the Word Airport Awards (Skytrax, 2014). Here is important to mention that some authors use a combination of sources to define the attributes. For instance, Practitioners and Awards (Bezerra & Gomes, 2015; Lupo, 2015), Practitioners and Literature review (Ibrahim, 2011; Liou et al., 2011) and Practitioners , Literature Review and Author (Tsai, Hsu, & Chou, 2011).

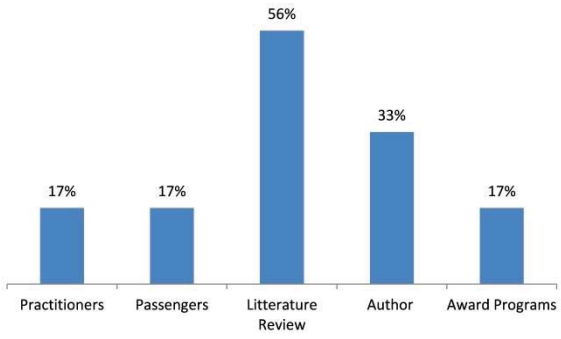

Figure 6-2. Attributes sources on ASQ research papers reviewed

With the aim to analyze which attributes are more commonly used on the ASQ evaluations, the 34 attributes used by ACI (2015) are used as the reference set (see Figure 6-3). Most reviewed attributes are included on the list, with only few exceptions: "On-time departure of flights" (J. W. Park & Jung, 2011; Tsai

et al., 2011); "Availability of lifts, escalators, walkways" (Chou, 2009; J. W. Park & Jung, 2011) and "art display" (Fodness & Murray, 2007).

From the 34 attributes included on the evaluation (see Figure 6-3), the attribute most frequently used (61% of papers) is "waiting time check-in queue", followed closely (56% of papers) by "easy of finding your way through airport" and "ambience of the airport". One attribute rarely used (6% of the papers) is the "overall satisfaction with the airport".

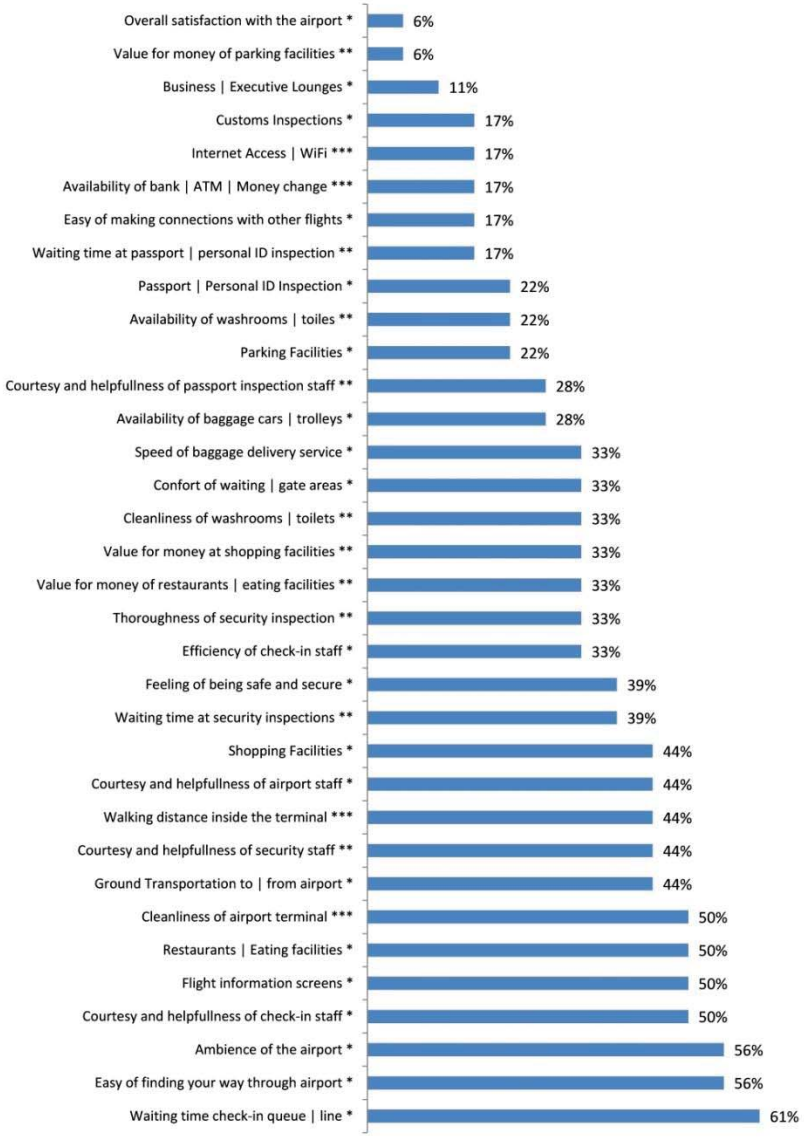

Figure 6-3. Attributes used on ASQ research papers reviewed

A selection of the attributes that comprise the construct under study ASQ is needed independently of the approach used to evaluate it. According to Lupo (2015), there are basically three main categories: stated importance methods (SIMs); derived importance methods (DIMs) and, more recently, those taking advantage of multi-criteria decision-making (MCDM) models. On one hand, SIMs are characterized by asking passengers to rate any of the triple of importance, perception and expectations on linguistic-numerical Likert type scales over a finite number of selected attributes. On the other hand, DIMs do derive the importance of different service attribute aspects through econometric models that analyze the relationship between performance of the service attributes and the overall passenger satisfaction. Finally, MCDM models that are based on multi-criteria value or utility theory (Dyer & Sarin, 1979; Keeney & Raiffa, 1993) are used as a natural extension for the multi-criteria decision process that rational passengers are expected to use when they make final choices. All these models or approaches have become very popular although some of them might be affected by several problems that can result in lack of robustness of the results obtained. It is out of the scope of this paper to provide a detailed comparison of the advantages and disadvantages of the three approaches regarding different techniques that have an effect on the results like normalization, aggregation rules, and weighting models that calculate the final SQI. According to Lupo (2015) SIMs are more intuitive and simple to use, they require a significant increase in the length of the survey and can sometimes yield insufficient differentiation among expectation ratings of service aspects. In our experience, the lack of variability in the data can also be problematic in DIMs and the lack of fit of the econometric models can invalidate the empirical exercise on the evaluation of ASQ. With respect to MCDM models, it can be said that they are also exposed to biased results as these are highly dependent on the survey used to get ASQ data. Eboli and Mazzulla (2011) contended that market segmentation or differentiation can represent a serious problem for both SIMs and DIMs but we would like to add in this respect that if the market segments are well represented in the sample, then different SQ scores can be obtained for each of the segments using SIMs or DIMs.

The three ASQ evaluation categories defined by (Lupo, 2015) are also reviewed: MCDM – Multi-Criteria Decision Making – is the evaluation

category most commonly used (Chou, 2009; Fernandes & Pacheco, 2008; Ibrahim, 2011; Kuo & Liang, 2011; Liou et al., 2011; Lupo, 2015; Tsai et al., 2011), followed by DIM – Derived Importance Methods – (Bogicevic, Yang, Bilgihan, & Bujisic, 2013; Janic, 2003; Merkert & Assaf, 2015; Rendeiro Martín-Cejas, 2006; Tam, Lam, & Lo, 2010, 2011). SIM - Stated Importance Methods – is the less common (Bezerra & Gomes, 2015; Fodness & Murray, 2007; Berendien Lubbe et al., 2011; J. W. Park & Jung, 2011; Sohail & Al-Gahtani, 2005).

6.3 Data

The airport industry has experienced very competitive and structural developments over recent years, and airports have evolved from public facilities to more market-oriented units, where active marketing strategies are being applied consistently in all the airports of the world. According to Fodness and Murray (2007), marketing did not play a significant role in the management of airports until the 1980s, prior to which time the airport was commonly viewed as a free public service or utility provided by governmental or quasi-governmental entities (p.493). ASQ is only a part of these marketing strategies that deals with a method that helps airport managers in understanding how they perform and how to improve if they adopt adequate directional SQ improvement programs. Unfortunately, the competitive market forces that affect the current airport industry make more difficult the access to good ASQ databases.

As said above, the IATA undertook since 1993 until 2001 a very popular annual service quality survey among airport and airlines managers and media. In this paper, the database for the year 1999, the seventh year of the lATA Global Airport Monitor will be used[21]. The IATA Global Airport Monitor was

[21] The author is aware that the database is very old and outdated, and that since then many technological airport processes have been invented and implemented. However, the aim of this

the precursor of the recent ACI ASQ, where a group of around 50 airports and 80.000 passengers were surveyed. ASQ, due to the international nature of the aviation industry, needs to be compared within a group of peer airports and it is no sufficient for an airport to track its service performance in isolation. Modern quality management systems require continuous monitoring of passenger satisfaction levels that help airport managers to elaborate SQ standards and to identify areas for improvement. Benchmarking is also very important to put the SQ performance of a single airport in an adequate context. The tools to help airport managers to position themselves in the global market in terms of passenger satisfaction and to learn from those leading airports how to envisage SQ improvement programs that increase satisfaction levels for their passengers if the airport is to survive in the years to come.

Our database provides comparative ASQ performance indicators for 57 major international airports from Europe, North America, the Middle East and the Asia-Pacific rim. The data analyses the perceptions of more than 42,517 international passengers across 24 service categories for both privately and publicly owned airports of various sizes for the 1999 calendar year. The lATA Global Airport Monitor is derived from 2 constituent surveys: (1) Surveys of international airline passengers that IATA conducts for airlines to provide competitive information to track their performance over time and relative to other airlines. The airline surveys also gather passenger ratings for both, departure and arrival airports; and (2) surveys of international passengers at airports that IATA developed whereby airports can participate in the Airport Monitor through separate or additional airport-based questionnaire distribution.

As the surveys were conducted internationally, versions of the questionnaire were available in a wide variety of languages including major European languages, Arabic, Japanese and Chinese. Both constituent surveys included

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paper is more related with the methodological proposal that calculates the synthetic index for ASQ (i.e., ranking). We really hope to have more recent data in order to apply our method and we have been contacting ACI in several occasions to define a proper work package without success until now.

core airport questions regarding the airport service at either end of the international flight, which formed the basis of comparative airport ratings. The airport questions were phrased and formatted identically on all surveys. There were two distribution methodologies used to issue the questionnaires to passengers on pre-selected flights: in-flight distribution by flight attendants and 'airside' distribution at the airport. Both followed criteria set by lATA to ensure the sample were random and consistent.

Table 6-2 shows the airports included in the analysis. It can be seen that the geographical distribution is as follows: Total (57); Europe (19); Asia & Middle East (16); and North America (22). The main airport hubs of the world were included in the sample, but it was evident that some geographical areas were underrepresented, for example Africa and South America. The database compares the ratings of airport services obtained from international passengers travelling between Europe and North America, Europe and Asia-Pacific, Europe and the Middle East, internally within Europe, or crossing the border US-Canada and Transpacific. Each passenger is asked to rate the services at the airport at either end of their international flight in a 5 point Likert scale, where 1 mean ‘very poor’ and 5 ‘excellent’. The number of respondents for each airport varied, however by summarizing all the data collected for a full year sample sizes were sufficient to make valid comparisons on most SQ attributes considered in the survey. The list of the twenty four SQ attributes included in the questionnaire can be consulted in Table 6-3. As it can be seen, the overall service is produced as a result of a combination of activities that can be produced by various types of organizations such as airlines, handling agents, security officials, immigration and customs staff, concessionaires and airports. These different organizations might have different ultimate objectives and different culture that will affect their vision and goals regarding what they consider good service quality.

Table 6-2. Airports included in the analysis

Europe		*Asia/Middle East*		*North America*	
Amsterdam Schiphol	AMS	Abu Dhabi	AUH	Atlanta William B. Hartsfield	ATL
Stockholm Arland	ARN	Bahrain	BAH	Boston/Logan	BOS
Birmingham	BHX	Bangkok	BKK	Greater Cincinnati	CVG
Brussels	BRU	Mumbai	BOM	Dallas Fort Worth	DFW
Paris Charles de Gaulle	CDG	Delhi Indira Gandhi	DEL	Detroit Metropolitan Wayne	DTW
Copenhagen	CPH	Dubai	DXB	Newark	EWR
Diisseldorf	DUS	Hong Kong Chek Lap Kok	HKG	Honolulu	HNL
Rome Fiumicino	FCO	Osaka - Kansai	KIX	Washington Dulles	IAD
Frankfurt Main	FRA	Kuala Lumpur	KUL	Houston	IAH
Helsinki Vantaa	HEL	Nagoya	NGO	New York JFK	JFK
London Gatwick	LGW	Beijing	PEK	Los Angeles	LAX
London I-leathrow	LHR	Perth	PER	Orlando	MCO
Madrid Barajas	MAD	Seoul Kimpo	SEL	Miami	MIA
Manchester	MAN	Singapore Changi	SIN	Minneapolis/St Paul	MSP
Munich	MUC	Sydney	SYD	Chicago O'Hare	ORD
Milan Malpensa	MXP	Taipei	TPE	Portland	PDX
Oslo Gardennoen	OSL			Seattle Tacoma	SEA
Palma de Mallorca	PMI			San Francisco	SFO
Zurich	ZHR			Montreal Dorval	YUL
				Vancouver	YVR
				Calgary	YYC
				Toronto Lester B. Person	YYZ

Source: Own elaboration

Another important drawback that presented the IATA Global Airport monitor survey was that the results for airports operating multiple international terminals are not reported by terminal. Survey coverage was not fully representative of all terminals, and results could be very different as some terminals varied considerably in terms of infrastructure. Since respondents are making international journeys, our ASQ results will reflect predominantly the service levels of the international terminals and facilities. The mix of respondents among business and leisure passengers to the survey for each airport also varied considerably. Thus, it is evident that those airports with the highest proportions of leisure passengers may benefit from higher overall ratings as business passengers tend to have higher expectations and rate airports more severely. Another cultural factor that can affect the results is nationality as nationals for a patriotism sense tend to rate their 'home' airport more favorably than foreigners Airports with samples consisting of more than 70% leisure passengers were Manchester, Palma de Mallorca, Honolulu, Orlando, Miami, Vancouver and Calgary Airport.

Table 6-3. Service quality attributes

Ambience of the airport *
Availability of baggage carts *
Baggage delivery service *
Business executive lounges *
Courtesy, friendliness of check-in staff *
Availability of connecting flights to city in another continent ***
Availability of connecting flights to city in same continent ***
Comfortable waiting areas/lounges *
Customs inspection *
Ease of making connections with other flights *
Ease of finding your way through airport/Signposting *
Efficiency of check-in staff *
Flight information screens *
Courtesy, friendliness of airport staff *
Ground transportation to/from city *
Overall satisfaction with airport *
On time departure ***
Parking facilities *
Passport/Visa Inspection **
Restaurants/eating facilities *
Sense of security *
Shopping facilities *
Waiting time at check-in *
Washrooms **
** IATA uses same attribute as ACI-ASQ; ** IATA uses attribute that combines two or more from ACI-ASQ list; *** IATA attribute is not used by ACI- ASQ*
Source: Own elaboration

Table 6-4 shows the statistical description for overall passenger satisfaction segmenting the sample by geographical area and trip purpose by both business and leisure passengers. Overall passenger satisfaction is treated here as other

SQ attributes which was rated alongside the other 23 additional SQ attributes. This attribute is different from the synthetic index that we will calculate below. It can be seen that the SQ leaders by region are Copenhagen, Singapore and Vancouver, that the overall order for all the passengers corresponds to Europe, Asia & Middle East and North America, that business passengers are generally more critical than leisure counterparts in their ratings, that for business passengers the position between Copenhagen and Singapore is reverted, that business passengers tend also to be a more heterogeneous group, that the SQ worst performers by region are Charles de Gaulle, Mumbai and Detroit for all passengers and business market segment, and that this is changed looking only at the leisure segment where Milan Malpensa, Delhi Indira Gandhi and Honolulu are the worst SQ performers.

Table 6-4. Descriptive statistics

Variables	Mean	SD	Min	Airport	Max	Airport
Overall Satisfaction with airport						
Europe	3.84	0.80	3.36	Charles de Gaulle	4.35	Copenhagen
Asia & Middle East	3.81	0.90	2.33	Mumbai	4.31	Singapore
North America	3.64	0.89	3.23	Detroit Metropolitan Wayne	4.25	Vancouver
Overall Satisfaction with airport (Business passengers)						
Europe	3.80	0.80	3.33	Charles de Gaulle	4.28	Copenhagen
Asia & Middle East	3.68	0.93	2.13	Mumbai	4.31	Singapore
North America	3.52	0.87	2.97	Detroit Metropolitan Wayne	4.27	Vancouver
Overall Satisfaction with airport (Leisure passengers)						
Europe	3.91	0.79	3.37	Milan Malpensa	4.38	Copenhagen
Asia & Middle East	3.82	0.91	2.21	Delhi Indira Gandhi	4.31	Singapore
North America	3.76	0.86	3.44	Honolulu	4.25	Vancouver

Source: Own elaboration

6.4 Methodology

The proposed method is based on a fuzzy model for group Multi Criteria Decision Making (MCDM). In our case MCDM will be used to calculate an ASQ index (ASQI) for all the airports included in the analysis. The answers to the questionnaire provide information for the ASQ attributes in linguistic terms that result in uncertain, imprecise, and vague information. Thus, how to aggregate this vague information poses a real challenge into the MCDM process. Nevertheless, this challenge has usually been overcome with the help of the fuzzy theory since the seminal work of Zadeh (1965).

As many authors contend the questionnaires, based mainly on ratings associated with linguistic terms like "poor", "fair", "good", and "excellent", provide very imprecise information which is perfectly handled by fuzzy measures (Benitez, Martin, & Roman, 2007). Basically, Fuzzy Logic handles the imprecise information adequately because intermediate values to be defined between exact and true conventional values can now be formulated mathematically and processed by computers in order to apply more human-like way of thinking in programming (Zadeh, 1984). Fuzzy sets are widely used in describing linguistic information because they can effectively blur the imprecise information provided by passengers' answers evaluating the ASQ attributes[22].

One of the most well-known classical MCDM methods that have been extensively applied in the literature is based on the Technique for Order Performance by Similarity to Ideal Solution (TOPSIS) developed by Hwang and Yoon (1981). It is based on the concepts that the best performance should have the shortest distance from the Positive Ideal Solution (PIS), and the

[22] Methods based on Fuzzy Logic are becoming very popular in the field of measuring satisfaction, service quality or experienced quality (Bai, Dhavale, & Sarkis, 2014; Benitez, Martin, & Roman, 2007; Kabir & Sumi, 2013; Lin, 2010; Seida Ardakani, Nejatian, Farhangnejad, & Nejati, 2015; Tsaur, Chang, & Yen, 2002; C. H. Yeh & Kuo, 2003).

farthest distance from the Negative Ideal Solution (NIS) (Benitez et al., 2007; Wang & Elhag, 2006). Although previous literature deals with some other service industries, in airports the applications are still scarce, and Lupo (2015) recommends to carry out research on ASQ evaluation using MCDM fuzzy TOPSIS method.

Following Zadeh (1975) and Mamdani and Assilian (1975), let the universe of discourse X be the subset of real numbers R, $X=\{x_1,x_2,x_3,\ldots,x_n\}$. A fuzzy set $\tilde{A}=\{(x,\mu_A(x))\,|\,x\in X\}$ in X is a set of ordered pairs, where $\mu_A(x)$ is called a membership function, and $\mu_A(x):X\rightarrow[0,1]$. The membership function for fuzzy sets can take any value from the closed interval [0,1]. The greater $\mu_A(x)$ is, the greater the truth of the statement that element x belongs to set A is.

In this paper, we are going to parameterize a triangular fuzzy number $\tilde{A}$ by a triplet (a_1,a_2,a_3). The membership function $\mu_A(x)$ is defined below as,

$$\mu_A(x)=\begin{cases}\dfrac{x-a_1}{a_2-a_1}, & a_1\le x\le a_2,\\ \dfrac{x-a_3}{a_2-a_3}, & a_2\le x\le a_3,\\ 0, & otherwise.\end{cases} \qquad (1)$$

Each linguistic term was characterized by a triangular fuzzy number for representing its approximate value range between 0 and 100[23], and denoted as (a_1,a_2,a_3), where $0\le a_1\le a_2\le a_3\le 100$. a_2 is the most likely value of the linguistic term, and a_1 and a_3 are the lower and upper bounds used respectively to reflect the fuzziness of the term. The default values of the linguistic terms are shown in Table 6-5 and the membership functions can be calculated according to the equation 1. The asymmetry of the extreme fuzzy numbers in the scale is well explained by the asymmetry of the scale used in the analysis.

[23] We have used this range, but other ranges, such as (0-1), (0-7) or (0-10) would also be valid.

Table 6-5. Triangular fuzzy numbers. Default values of linguistic terms

Linguistic terms	Fuzzy Number
Very Poor (0)	(0,0,30)
Poor	(20,30,40)
Fair	(30,50,70)
Good	(60,70,80)
Excellent	(70,100,100)

Source: Own elaboration.

Vagueness of linguistic terms about satisfaction degree has already been set up. So in order to provide more objective information for the analysis, we have fuzzified satisfaction degree as triangular fuzzy numbers and aggregated group opinions of consumers according to the average fuzzy number of n triangular numbers $\tilde{A}_i = \left(a_1^{(i)}, a_2^{(i)}, a_3^{(i)}\right)$, where $i = 1,2,3,\ldots,n$, as follows:

$$\tilde{A} = \left(a_1, a_2, a_3\right) = \left(\frac{1}{n}\right) \bullet \left(\tilde{A}_1 \oplus \tilde{A}_2 \oplus \cdots \tilde{A}_n\right) = \left(\frac{\sum_{i=1}^{n} a_1^{(i)}, \sum_{i=1}^{n} a_2^{(i)}, \sum_{i=1}^{n} a_3^{(i)}}{n} \right) \quad (2)$$

where $\bullet$ is the multiplication of a scalar and a fuzzy number, and $\oplus$ is the add operation of fuzzy numbers, so $\tilde{A}$ is the overall average performance valuation of each segment included in the analysis. Eq. (2) shows that the average performance can be represented by a new triangular fuzzy number (Buckley, 1985).

6.4.1 Defuzzification. Crisp Information. The TOPSIS Method

To justify whether the performance of some attribute is weak or strong, we need to defuzzy the information obtained above. The result of fuzzy synthetic information of each observation is a fuzzy number. Therefore, it is necessary to employ some nonfuzzy ranking method for fuzzy numbers during the empirical exercise for each segment. In other words, Defuzzification is a technique to convert the fuzzy number into crisp real numbers. The procedure of defuzzification is to locate the Best Nonfuzzy Performance (BNP) value. This purpose can be attained by several available methods. Mean-of-Maximum, Center-of-Area, and α-cut Method (Zhao & Govind, 1991) are some of the most common approaches. Nevertheless, recently there are new methods like for example Bonferroni means (BM) or other extensions of these that are based on the original ideas proposed by Bonferroni and Yager (Bonferroni, 1950; Xu, 2011; Yager, 2009).

In this paper, we have preferred to use the well-known BNP value, comparing the performance of two triangular fuzzy numbers using $v_{\tilde{A}}$ defined as follows, $v_{\tilde{A}} = (a_1 + 2a_2 + a_3)/4$ for the triplet (a_1, a_2, a_3) of a triangular fuzzy number $\tilde{A}$. This method (S.-M. Chen, 1996) has been chosen due to its simplicity and the lack of requirement of analyst's personal judgment. The method is based on Kaufmann and Gupta's method to compare fuzzy numbers and its logic is underpinned in the definition of the removal of a fuzzy number (Kaufmann & Gupta, 1988). Thus, we can obtain $v_{\tilde{A}}$ for each dimension that will be used in the next step.

The multi-attribute evaluation problem characterized by the crisp performance matrix is resolved applying a method which is based on the concept of the degree of optimality rooted in a best virtual alternative formed by different alternatives where multiple attributes characterize their achievement and the notion of the best (Zeleny, 1982). As said, a TOPSIS method is applied (Hwang & Yoon, 1981) in which the ideal solutions need to be obtained.

Thus, ideal solutions are computed based on the following equations:

$$A^{+} = \left\{ \left(\max v_{ij} \mid j \in J \right), \left(\min v_{ij} \mid j \in J' \right), i = 1, 2, \ldots, m \right\} \quad (3)$$

$$A^{-} = \left\{ \left(\min v_{ij} \,|\, j \in J \right), \left(\max v_{ij} \,|\, j \in J' \right), i = 1,2,\ldots,m \right\} \quad (4)$$

where J and J' form a partition of the different criteria according to their benefit or cost characteristic. In our case there are no dimensions with cost characteristics.

After the determination of ideal solutions, we calculate the Euclidean distance between ideal solution and negative ideal solution for each observation as

$$S_i^{+} = dist(V_i, A^{+}) = \sqrt{\sum_{j=1}^{n} \left(V_{ij} - A_j^{+} \right)^2} \quad i = 1,2,\ldots,m \qquad (5)$$

$$S_i^{-} = dist(V_i, A^{-}) = \sqrt{\sum_{j=1}^{n} \left(V_{ij} - A_j^{-} \right)^2} \quad i = 1,2,\ldots,m \qquad (6)$$

Then we calculate the relative closeness to the positive ideal solution of each of the segments, such as

$$ASQI_i = \frac{S_i^{-}}{S_i^{+} + S_i^{-}} \quad i = 1,2,\ldots,m, \quad (7)$$

where $0 \le ASQI_i \le 1$. An observation is closer to an ideal solution as ASQI_i approaches to 1. Thus, the airports ranking performance can be obtained according to the descending order of ASQI_i.

This approach has been widely used in different decision contexts (e.g.: Athanassopoulos & Podinovski, 1997; Bai & Sarkis, 2013; Chang & Yeh, 2001; Chen & Hwang, 1992; Min & Peng, 2012; Yeh, Deng, & Chang, 2000; Zeleny, 1998). This is mainly due to its applicability in solving different scenarios of human decision problems; and its mathematical simplicity measuring the relative performance of the alternatives.

The rationale behind (7) is that a better performance of a particular airport should be captured by a higher degree of similarity to the positive ideal solution and a lower degree of similarity to the negative ideal solution. The larger the performance index, the better the overall ASQI performance of the airport. As such, the performance index calculated is a relative concept and it could be used to analyze the performance of the airports or group of airports that can be of interest to researchers.

6.4.2 ASQI Elasticities

Once we have calculated AS*QI*, another remarkable variable of interest for airport managers that can be calculated is the elasticity of the overall SQ synthetic indicator for each attribute and airport. Elasticity is a major economic concept and has its origin in physics. It serves to quantify the sensitivity (which may be positive or negative) that a variable experiences in changing another. In our case, we assume that there is a functional dependence between the AS*QI* and attributes that form it, and therefore, the elasticity measures the responsiveness of the overall service quality at a small variation in the attribute on which we are calculating the elasticity. That is why the elasticity can be understood or defined as the percentage change in service quality for each attribute of quality. In mathematical notation, the elasticity can be calculated for each airport *i* and each SQ attribute *j* as:

$$\eta_{ij} = \frac{\Delta\%ASQI_i}{\Delta\%\mathrm{V}_{ij}} = \frac{dASQI_i}{dv_{ij}}\frac{v_{ij}}{ASQI_i} \qquad (8)$$

Elasticity values can help airport managers and other stakeholders to determine the critical success attributes (CSAs) that guarantee and adequate airport service quality. Knowing these attributes is paramount to develop strategies and programs that improve airport passengers' satisfaction which is a main driver to achieve passengers' loyalty in the future, and thus ensure the competitiveness and sustainability of the airport in the long-run.

6.5 Results

After obtaining a measure of evaluation in terms of fuzzy numbers, it is necessary to clarify the information to apply the TOPSIS ranking procedure. For this, a common procedure that requires obtaining the worst and best evaluations for each analysed conference is used. Table 6-6 shows both positive and negative ideal solutions for the airports included in the study. It can be seen that the table contains six columns. In the first the designation of each of the 24 attributes analysed appears. In the second and third columns, the vector of positive ideal solution and the airport which obtained the highest

rating are presented. It can be seen that the positive ideal airport is highly characterized by Copenhagen, Singapore and Helsinki observations. The first two airports were the overall satisfaction leaders in Europe and Asia, respectively. The case of Vancouver is paradigmatic as being the leader in North America, the airport only outperforms the rest of the airports for the SQ attribute 'comfortable waiting areas/lounges'. The fourth and fifth columns are similar to the above but focusing now on the worst observation –the negative ideal airport. In this case, the airport is characterized by the following peers: Mumbai, Delhi, Honolulu and Washington Dulles. However, Mumbai presented the worst observation for nineteen out of twenty four observations. Delhi airport is the only airport which presented the best and the worst observation in some attribute. In this specific case, it can be seen that Delhi outperformed in 'on time departure' and underperformed in 'restaurants/eating facilities'.

If we analyse the table by SQ attributes, the following information can be extracted. When focusing on the positive ideal solution, the best observations are obtained in the following dimensions: 'business executives lounges' (MIA), 'courtesy, friendliness of check-in staff' (MCO), and 'efficiency of check-in staff' (FCO). These three best observations are located in the two airports of Florida, Miami and Orlando, and in Rome Fiumicino. When analysing the ideal negative solution, it appears that the worst dimensions are: 'courtesy, friendliness of check-in staff' (HNL), 'efficiency of check-in staff' (HNL), and 'waiting time at check-in' (IAD). In this case, only two airports are involved, Honolulu and Washington Dulles. It is particularly relevant that these attributes were usually operated by airlines or handling operators. Finally, in analysing the percentage change between the ideal solutions, it can be seen that the dimensions with greatest heterogeneity are: 'washrooms', 'ambience of the airport', and 'comfortable waiting areas/lounges', that depended more directly on the airport management. The other extreme of attributes that presented more homogeneous results is characterized by 'courtesy, friendliness of check-in staff', 'efficiency of check-in staff', and 'waiting time at check-in'.

Table 6-6. Positive and negative ideal solutions for airports

Attribute	Apos	Airport^{+}	Aneg	Airport^{-}	% var
Ambience of the airport	76,80	'SIN'	32,63	'BOM'	135,39%
Availability of baggage carts	75,55	'MAN'	47,18	'BOM'	60,15%
Baggage delivery service	71,76	'SIN'	40,20	'BOM'	78,51%
Business executive lounges	81,79	'MIA'	53,13	'BOM'	53,95%
Courtesy, friendliness of check-in staff	80,95	'MCO'	61,62	'HNL'	31,38%
Availability of connecting flights to city in another continent	75,63	'SIN'	51,35	'BOM'	47,27%
Availability of connecting flights to city in same continent	76,50	'DFW'	50,10	'BOM'	52,69%
Comfortable waiting areas/lounges	73,98	'YVR'	33,00	'BOM'	124,17%
Customs inspection	74,97	'HEL'	42,50	'BOM'	76,41%
Ease of making connections with other flights	70,93	'SIN'	40,90	'BOM'	73,41%
Ease of finding your way through airport/Signposting	77,88	'PER'	45,03	'BOM'	72,96%
Efficiency of check-in staff	80,30	'FCO'	62,63	'HNL'	28,23%
Flight information screens	75,98	'CPH'	42,55	'BOM'	78,55%
Courtesy, friendliness of airport staff	75,95	'CPH'	46,80	'BOM'	62,29%
Ground transportation to/from city	73,93	'ZHR'	40,50	'BOM'	82,53%
Overall satisfaction with airport	78,23	'CPH'	36,48	'BOM'	114,46%
On time departure	78,84	'DEL'	49,22	'IAD'	60,18%
Parking facilities	72,80	'PER'	38,60	'BOM'	88,61%
Passport/Visa Inspection	75,63	'HEL'	35,05	'BOM'	115,76%
Restaurants/eating facilities	68,75	'CPH'	39,40	'DEL'	74,49%
Sense of security	78,03	'SIN'	45,70	'BOM'	70,73%
Shopping facilities	75,32	'CPH'	34,26	'BOM'	119,87%
Waiting time at check-in	78,40	'MCO'	56,36	'IAD'	39,10%
Washrooms	73,78	'HEL'	30,25	'BOM'	143,90%
Source: Own elaboration					

These behavioural patterns must be analysed by all airport managers, regulators and other stakeholders involved in enhancing the SQ of airports as a competitive strategy to improve airports' performance. In this way for example, it follows that some results can be explained by the different characteristics of traffic mix serviced at the airports. Elaborating on the results, it can be stated that if airport managers intend to design specific mechanisms of incentives for employees to improve those dimensions that rely on direct contact between passengers and services personnel, airport managers should be flexible when analysing the dynamic evolution of the evaluation of each attribute. It is hoped, that after a certain period of good evaluations declines will take place in the results. If employees are subjected to a rigid incentives system, strategic behaviours that make workers deliberately slow down the

process of increasing service quality in order to avoid future decreases will naturally occur, so that in the future they will not be as significant in relative terms (Freixas, Guesnerie, & Tirole, 1985; Laffont & Tirole, 1988). Other important aspects that can influence the quality assessment include job rotation, focusing especially, in this sense, on the temporary nature of the contracts. In this regard, airport managers and regulators must be able to weigh the positive and negative effects in reducing temporary employment contracts. While it is true that a newly hired worker generally has a high level of compliance, the quality of many of the services provided in this segment is very sensitive to the experience of the workers involved in them.

Table 6-7 shows the results obtained after applying the TOPSIS (left side) and the average (right side) indicators measuring the overall quality of service obtained by the 10 best and worst airports in the sample under analysis. Comparing the two rankings (ASQI and Average), both include a very similar list of airports. One difference however is the ranking order of the best 3 airports, which could have some marketing consequences. ASQI includes Helsinki, Vancouver and Manchester, while the Average includes Helsinki, Copenhagen and Singapore. Airport quality assessments are used to create airports awards (ACI, 2015b) and those awards are used for marketing purposes. Figure 3 shows how Singapore Changi promotes on its website the quality award received in 2014 from ACI.

Figure 6-4. Singapore Changi airport: quality award (Changi, 2014)

It can be seen that those airports which presented a good and bad performance on ‘the overall satisfaction with airport’ are located in the top and the bottom

area of the table. Thus, it can be said that the validity of the TOPSIS approach has been confirmed. Those airports that play a determinant role in obtaining the positive and negative ideal airport solution are also located in the same areas. It can be seen that the top five airport performers are: Helsinki Vantaa, Vancouver, Manchester, Copenhagen, and Singapore Changi. These airports could have been considered as the SQ leaders that presented the 'the best SQ performance'. The rest of the airports could have learnt from the services provided at these reference leaders. On the other extreme, it can be seen that Taipei, Seoul Kimpo, Beijing, Delhi Indira Gandhi, and Mumbai are the five worst performer airports. In spite of the fact that Taipei, Seoul Kimpo, and Bejing did not present any attribute in the negative ideal airport solution, it can be seen that the overall performance is even worse than airports like Honolulu and Washington Dulles that were representative of this particular solution. It is surprising that all the worst SQ airports are located in some important cities in Asia, and some of them are even the capital cities of important countries. For these airports, Singapore could have been considered a reference point to look at. However, these results should not be transferred to the current situation as Adler et al. (2014) found that air transport liberalization in the Northeast Asian area will benefit both consumers and the aviation industry in the region, albeit to varying degrees, but in any case the welfare gains will be derived from service quality increases. Ohri (2009) contended that India is characterized by historical political problems in the Public Sector Units (PSUs), like airports in Delhi and Mumbai, and that the privatization of these airports was done with a strong opposition by The Left Front and the Employee Unions. In any case, readers are advised not to take these rankings statically, as a large number of years have elapsed since 1999 and the best SQ airports in Asia according to the 2014 ASQ-ACI awards are: Seoul, Singapore, Bejing, Hakou and New Delhi.

It results evident that in this group of airports, however, all departments with the persons responsible for the management of them have analysed their behaviour and corrected, as far as possible some processes that were inappropriate and that caused this unsatisfactory quality performance. A strategic plan has been established with a positive assessment and compromise of the employees of the department, in which barriers to changes have been minimized. All the measures have taken into account the procedures,

employee's attitudes and skills in order to have achieved these SQ improvements.

Table 6-7. The 10 best and worst airports according to the ASQI and average

RankASQI	Airport	ASQI	RankAvg	Airport	Avg
		10 Best Airports			
1	Helsinki	0,8659113	1	Helsinki	4,0912253
2	Vancouver	0,8473881	2	Copenhagen	4,0703416
3	Manchester	0,8457025	3	Singapore	4,0668568
4	Copenhagen	0,8424826	4	Vancouver	4,0453633
5	Singapore	0,8392795	5	Manchester	4,0372083
6	Hong Kong	0,8057472	6	Hong Kong	3,957782
7	Kuala Lumpur	0,7872818	7	Zurich	3,9394437
8	Amsterdam	0,7860368	8	Kuala Lumpur	3,9337628
9	Zurich	0,7740159	9	Amsterdam	3,9575608
10	Cincinnati	0,7462785	10	Perth	3,9135303
		10 Worst Airports			
48	Paris CDG	0,5040233	48	Paris CDG	3,4857524
49	Los Angeles	0,4903563	49	New York JFK	3,4547758
50	New York JFK	0,485714	50	Los Angeles	3,4776471
51	Honolulu	0,4798137	51	Taipei	3,4019013
52	Detroit Metropolitan	0,4763764	52	Detroit Metropolitan	3,4418602
53	Taipei	0,4709568	53	Honolulu	3,4432951
54	Seoul Kimpo	0,4165974	54	Seoul Kimpo	3,3476445
55	Beijing	0,4042483	55	Beijing	3,3095548
56	Delhi Indira Gandhi	0,2737077	56	Delhi Indira Gandhi	3,0922075
57	Mumbai	0,1541498	57	Mumbai	2,8392961

Source: Own elaboration

Table 6-7 and Table 6-8 show the value of the elasticity of the overall quality of service for the five best and worst airports in the sample. The elasticity can be understood or defined as the percentage change in quality for each attribute of quality. It can be seen that all calculated elasticity shows that the overall quality is more or less SQ inelastic with respect to each specific SQ attribute and that results depend very on the selected airport for the analysis. For ease of exposition, the results for Helsinki and Mumbai will be more deeply commented as an example that can be used for the rest of the airports included in the tables. It can be seen that, in general, the airport SQ is more inelastic in the group of best performers.

On one hand, for example, analysing the results for Helsinki, the SQ is quite inelastic with respect to all the attributes. However, the SQ is more elastic with respect to: 'on time departure' (0.2155), 'business executive lounges' (0.2063), and 'availability of connecting flights to city in same continent' (0.1612); and

less elastic or almost rigid with respect to: 'customs inspection' (0.0279), 'courtesy, friendliness of airport staff' (0.0320), and 'passport/visa inspection' (0.0322). We can conclude that in Helsinki in the year 1999, the ASQ was highly sensitive with respect to those attributes which depend more directly on the airlines that operate to/from the airport. Thus, ASQ improvement programs should have been coordinated with Finnair, the airline that had its base in Helsinki. A very surprising result is the one obtained for the 'courtesy, friendliness of airport staff' as this attribute is usually one of the attributes that show a more elastic behaviour.

On the other hand, Mumbai shows a more elastic behaviour with respect to: 'waiting time at check-in' (0.9932), 'on time departure' (1.0123), and 'courtesy, friendliness of check-in staff' (1.0983). It can be seen that this airport is even elastic with respect to the two last mentioned attributes. These attributes are more related with activities that airlines or handling operators perform in the airports. Analysing those attributes which presented a more inelastic behaviour, we obtained the following: 'ease of making connections with other flights' (0.0478), 'availability of connecting flights to city in same continent' (0.0469), and 'availability of connecting flights to city in another continent' (0.0435). Connectivity is one of the key performance indicators to succeed when airport managers have the vision on developing an important hub airport. For example, Gupta, Arif & Richardson (2014) showed that one of the main strengths of United Arab Emirates (UAE) airports is that geography plays a decisive role in favour of the political support to become a hub airport between Europe and Far East. Again, these results should be taken in this case as a practical guidance tool that could be developed if more recent data be available to researchers. Our main conclusion is that there are no magical recipes and each airport has to find its own strategic SQ improvement program. All airports need to learn to focus on key performance factors that their passengers value most. It is very important to realize that what pleases a passenger today becomes tomorrow's expectation, and that to provide a top SQ performance, an airport must continuously innovate in order to excel passengers' expectations on current and future trips.

Table 6-8. SQ elasticities for the five best airports

Attribute	Helsinki Vantaa	Vancouver	Manchester	Copenhagen	Singapore Changi
Ambience of the airport	0.0648	0.0706	0.1411	0.0579	0.0342
Availability of baggage carts	0.0692	0.0645	0.0296	0.0673	0.0530
Baggage delivery service	0.0519	0.0818	0.0986	0.0938	0.0249
Business executive lounges	0.2063	0.1848	0.1759	0.1621	0.1785
Courtesy, friendliness of check-in staff	0.0962	0.0917	0.0913	0.0780	0.1226
Availability of connecting flights to city in another continent	0.1579	0.1118	0.1326	0.1101	0.0223
Availability of connecting flights to city in same continent	0.1612	0.1143	0.1146	0.0618	0.0390
Comfortable waiting areas/lounges	0.1227	0.0344	0.0950	0.0719	0.0464
Customs inspection	0.0279	0.1216	0.0665	0.0996	0.0566
Ease of making connections with other flights	0.0787	0.0512	0.0488	0.0463	0.0238
Ease of finding your way through airport/Signposting	0.0837	0.0872	0.1074	0.0479	0.0757
Efficiency of check-in staff	0.0991	0.0962	0.0891	0.1107	0.1395
Flight information screens	0.0550	0.1145	0.1083	0.0283	0.0629
Courtesy, friendliness of airport staff	0.0320	0.0442	0.0379	0.0258	0.0654
Ground transportation to/from city	0.1113	0.1181	0.0883	0.0284	0.0750
Overall satisfaction with airport	0.0699	0.0786	0.1105	0.0341	0.0457
On time departure	0.2155	0.1982	0.2021	0.2409	0.2148
Parking facilities	0.0984	0.1218	0.1105	0.1188	0.0868
Passport/Visa Inspection	0.0322	0.1099	0.0721	0.0744	0.0792
Restaurants/eating facilities	0.0367	0.0285	0.0939	0.0233	0.1605
Sense of security	0.0709	0.1116	0.1112	0.0973	0.0278
Shopping facilities	0.0651	0.1431	0.1489	0.0322	0.0564
Waiting time at check-in	0.1060	0.1352	0.1241	0.1491	0.0977
Washrooms	0.0328	0.0466	0.0972	0.0499	0.0358
Source: Own elaboration					

6.6 Conclusions

This study contributed to the body of knowledge of ASQ by using the IATA Global Airport Monitor database as well as to the research methodology by proposing a TOPSIS Fuzzy method to calculate the ASQ synthetic indicator. Our approach produced a valid tool to rank the SQ performance of fifty seven world airport hubs. The positive and negative ideal airports explained the different behavior observed by region and some airports could be envisaged as good and bad SQ performers.

The ranking generated with this approach produces similar results as the more traditional rankings generated based on averages. However, differences were

observed in the best three airports which could have important influences on the quality awards that the best performance airports receive.

Another good contribution of this study is based on the demonstration of the value of the SQ elasticities in finding and developing adequate SQ improvement programs for the future. Using our method, this study examined the SQ elasticities for a group of airports. Our findings regarding various scores provide examples of how this method can be employed in obtaining the key performance attributes that need to be improved for each particular airport. An airport should examine those attributes that would lead to strong SQ gains of their passengers. We showed that there are no magical recipes and each airport need to analyze these key SQ attributes. Another collateral finding showed that some of these attributes are more in the managerial processes of other entities such as handling operators, airlines or security and customs staff. For this reason, ASQ programs should be coordinated among different economic agents that could have different objectives and culture.

Several limitations of this study must be recognized. To begin with, the database is certainly outdated and all our efforts to obtain more recent data have been, so far, unfruitful. The underlying twenty four attributes used in the analysis might not be a valid scale for the ASQ construct and other SQ attributes included in the new ACI-ASQ survey could be very important. Hopefully, this drawback could be partly compensated by the large respondents' number that has been used. Future studies are advised to take into account these drawbacks, and if possible to disaggregate the attributes in different sets among groups of passengers regarding their profiles and motivation. For example, there will be a need to obtain ASQ indicators regarding departing, arrival or connecting passengers, or business and leisure passengers, or any other profile of interest for airport managers. These aspects seem to be major challenges for the future agenda of research on Airport Service Quality.

6.7 References

ACI. (2000). Airport Council International - Quality of Service at Airport: Standards and Measurements, 1st Edition.

ACI. (2014). Airport Quality Award 2013. Retrieved June 15, 2015, from http://www.aci.aero/Airport-Service-Quality/ASQ-Awards/Past-Winners/2013

ACI. (2015). ASQ Award Winners 2014. Retrieved June 15, 2015, from http://www.aci.aero/Airport-Service-Quality/ASQ-Awards/Current-Winners

Adler, N., Fu, X., Oum, T. H., & Yu, C. (2014). Air transport liberalization and airport slot allocation: The case of the Northeast Asian transport market. Transportation Research Part A: Policy and Practice, 62, 3–19. http://doi.org/10.1016/j.tra.2014.02.003

Airbus. (2014). Global Market Forecast 2014-2033 | Airbus, a leading aircraft manufacturer. Retrieved May 19, 2015, from http://www.airbus.com/company/market/forecast/

Ashford, N. (1988). Level of service design concept for airport passenger terminals—a European view. Transportation Planning and Technology, 12(1), 5–21. http://doi.org/10.1080/03081068808717356

ATAG. (2014). Aviation Benefits Beyond Borders - Powering global economic growth, employment, trade links, tourism and support for sustainable development through air transport. Retrieved from http://aviationbenefits.org/

Athanassopoulos, A. D., & Podinovski, V. V. (1997). Dominance and potential optimality in multiple criteria decision analysis with imprecise information. Journal of the Operational Research Society, 48(2), 142–150.

ATRS. (2014). Global Airport Benchmarking Report. Retrieved from http://atrsworld.org/publications.html

BAA. (2002). British Airport Authority. BAA (2002). Market Research Group, The Quality of Service Monitor.

Bai, C., Dhavale, D., & Sarkis, J. (2014). Integrating Fuzzy C-Means and TOPSIS for performance evaluation: An application and comparative analysis. Expert Systems with Applications, 41(9), 4186–4196. http://doi.org/10.1016/j.eswa.2013.12.037

Bai, C., & Sarkis, J. (2013). Green information technology strategic justification and evaluation. Information Systems Frontiers, 15(5), 831–847. http://doi.org/10.1007/s10796-013-9425-x

Benitez, J. M., Martin, J. C., & Roman, C. (2007). Using fuzzy number for measuring quality of service in the hotel industry. Tourism Management, 28(2), 544–555.

Bezerra, G. C. L., & Gomes, C. F. (2015). The effects of service quality dimensions and passenger characteristics on passenger's overall satisfaction with an airport. Journal of Air Transport Management, 44–45, 77–81. http://doi.org/10.1016/j.jairtraman.2015.03.001

Bogicevic, V., Yang, W., Bilgihan, A., & Bujisic, M. (2013). Airport service quality drivers of passenger satisfaction. Tourism Review, 68(4), 3–18. http://doi.org/10.1108/TR-09-2013-0047

Bonferroni, C. (1950). Sulle medie multiple di potenze. Bollettino dell'Unione Matematica Italiana, 5(3-4), 267–270.

Buckley, J. J. (1985). Ranking alternatives using fuzzy numbers. Fuzzy Sets and Systems, 15(1), 21–31. http://doi.org/10.1016/0165-0114(85)90013-2

Changi. (2014). Sıngapore Changi International Airport Awards. Retrieved October 26, 2015, from Source:http://www.changiairport.com/en/aboutus.html?tab=awards-accolades-2014

Chang, Y.-H., & Yeh, C.-H. (2001). Evaluating airline competitiveness using multiattribute decision making. Omega, 29(5), 405–415. http://doi.org/10.1016/S0305-0483(01)00032-9

Chen, S.-J., & Hwang, C.-L. (1992). Fuzzy Multiple Attribute Decision Making Methods. In Fuzzy Multiple Attribute Decision Making (pp. 289–486). Springer Berlin Heidelberg. Retrieved from http://link.springer.com/chapter/10.1007/978-3-642-46768-4_5

Chen, S.-M. (1996). Evaluating weapon systems using fuzzy arithmetic operations. Fuzzy Sets and Systems, 77(3), 265–276. http://doi.org/10.1016/0165-0114(95)00096-8

Chou, C.-C. (2009). A model for the evaluation of airport service quality. Proceedings of the ICE - Transport, 162(4), 207–213. http://doi.org/10.1680/tran.2009.162.4.207

Chou, C.-C., Liu, L.-J., Huang, S.-F., Yih, J.-M., & Han, T.-C. (2011). An evaluation of airline service quality using the fuzzy weighted SERVQUAL method. Applied Soft Computing, 11(2), 2117–2128. http://doi.org/10.1016/j.asoc.2010.07.010

Correia, A. R., & Wirasinghe, S. C. (2004). Evaluating Level of Service at Airport Passenger Terminals: Review of Research Approaches. Transportation Research Record: Journal of the Transportation Research Board, 1888, 1–6. http://doi.org/10.3141/1888-01

Correia, A. R., & Wirasinghe, S. C. (2007). Development of level of service standards for airport facilities: Application to São Paulo International Airport. Journal of Air Transport Management, 13(2), 97–103. http://doi.org/10.1016/j.jairtraman.2006.10.002

Correia, A. R., & Wirasinghe, S. C. (2010). Level of service analysis for airport baggage claim with a case study of the Calgary International Airport. Journal of Advanced Transportation, 44(2), 103–112. http://doi.org/10.1002/atr.113

Correia, A. R., Wirasinghe, S. C., & de Barros, A. G. (2008). Overall level of service measures for airport passenger terminals. Transportation Research Part A: Policy and Practice, 42(2), 330–346. http://doi.org/10.1016/j.tra.2007.10.009

Dyer, J. S., & Sarin, R. K. (1979). Measurable Multiattribute Value Functions. Operations Research, 27(4), 810–822. http://doi.org/10.1287/opre.27.4.810

Erdil, S. T., & Yıldız, O. (2011). Measuring service quality and a comparative analysis in the passenger carriage of airline industry. Procedia - Social and Behavioral Sciences, 24, 1232–1242. http://doi.org/10.1016/j.sbspro.2011.09.117

Fernandes, E., & Pacheco, R. R. (2008). A quality approach to airport management. Quality & Quantity, 44(3), 551–564. http://doi.org/10.1007/s11135-008-9212-9

Fodness, D., & Murray, B. (2007). Passengers' expectations of airport service quality. Journal of Services Marketing, 21(7), 492–506. http://doi.org/10.1108/08876040710824852

Freixas, X., Guesnerie, R., & Tirole, J. (1985). Planning under Incomplete Information and the Ratchet Effect. The Review of Economic Studies, 52(2), 173–191. http://doi.org/10.2307/2297615

Graham, A. (2013). Managing airports: an international perspective. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&scope=site&db=nlebk&db=nlabk&AN=652617

Gupta, A., Arif, M., & Richardson, P. (2014). Assessing Customer Service in Airports – Models from the UAE. International Journal of Aviation, Aeronautics, and Aerospace, 1(2). http://doi.org/10.15394/ijaaa.2014.1007

Han, S., Ham, S. (Sunny), Yang, I., & Baek, S. (2012). Passengers' perceptions of airline lounges: Importance of attributes that determine usage and service quality measurement. Tourism Management, 33(5), 1103–1111. http://doi.org/10.1016/j.tourman.2011.11.023

Hwang, C. L., & Yoon, K. (1981). Multiple attribute decision making: methods and applications : a state-of-the-art survey. Berlin; New York: Springer-Verlag.

IATA. (2000). International Air Transport Association - IATA Global Airport Monitoring 2000.

Ibrahim, H. (2011). Assessing service quality within airport industry. TECNIAJournal of Management Studies, 1.

Janic, M. (2003). Assessment and Management of Quality of Service at an Airport Passenger Terminal. Transportation Planning and Technology, 26(3), 239–263. http://doi.org/10.1080/0308106032000154460 1

Kabir, G., & Sumi, R. S. (2013). Evaluation of Travel Website Service Quality Using Fuzzy Topsis. Suranaree Journal of Science & Technology, 20(1), 21–33.

Kaufmann, A., & Gupta, M. M. (1988). Fuzzy mathematical models in engineering and management science. Amsterdam; New York; New York, N.Y., U.S.A.: North-Holland ; Sole distributors for the U.S.A. and Canada, Elsevier Science Pub. Co.

Keeney, R. L., & Raiffa, H. (1993). Decisions with Multiple Objectives: Preferences and Value Trade-Offs. Cambridge University Press.

Kuo, M.-S., & Liang, G.-S. (2011). Combining VIKOR with GRA techniques to evaluate service quality of airports under fuzzy environment. Expert Systems with Applications, 38(3), 1304–1312. http://doi.org/10.1016/j.eswa.2010.07.003

Laffont, J.-J., & Tirole, J. (1988). The Dynamics of Incentive Contracts. Econometrica, 56(5), 1153–1175. http://doi.org/10.2307/1911362

Lin, H.-F. (2010). An application of fuzzy AHP for evaluating course website quality. Computers & Education, 54(4), 877–888. http://doi.org/10.1016/j.compedu.2009.09.017

Liou, J. J. H., Tang, C.-H., Yeh, W.-C., & Tsai, C.-Y. (2011). A decision rules approach for improvement of airport service quality. Expert Systems with Applications, 38(11), 13723–13730. http://doi.org/10.1016/j.eswa.2011.04.168

Lubbe, B., Douglas, A., & Zambellis, J. (2011). An application of the airport service quality model in South Africa. Journal of Air Transport Management, 17(4), 224–227. http://doi.org/10.1016/j.jairtraman.2010.08.001

Lupo, T. (2015). Fuzzy ServPerf model combined with ELECTRE III to comparatively evaluate service quality of international airports in Sicily. Journal of Air Transport Management, 42, 249–259. http://doi.org/10.1016/j.jairtraman.2014.11.006

Mamdani, E. H., & Assilian, S. (1975). An experiment in linguistic synthesis with a fuzzy logic controller. International Journal of Man-Machine Studies, 7(1), 1–13. http://doi.org/10.1016/S0020-7373(75)80002-2

Merkert, R., & Assaf, A. G. (2015). Using DEA models to jointly estimate service quality perception and profitability – Evidence from international airports. Transportation

Research Part A: Policy and Practice, 75, 42–50. http://doi.org/10.1016/j.tra.2015.03.008

Min, J., & Peng, K.-H. (2012). Ranking emotional intelligence training needs in tour leaders: an entropy-based TOPSIS approach. Current Issues in Tourism, 15(6), 563–576. http://doi.org/10.1080/13683500.2011.641946

Müller, C., & Gosling, G. D. (1991). A framework for evaluating level of service for airport terminals. Transportation Planning and Technology, 16(1), 45–61. http://doi.org/10.1080/03081069108717470

Ohri, M. (2009). Discussion Paper: Airport Privatization in India. Networks and Spatial Economics, 12(2), 279–297. http://doi.org/10.1007/s11067-009-9117-8

Oum, T. H., Yu, C., & Fu, X. (2003). A comparative analysis of productivity performance of the world's major airports: summary report of the ATRS global airport benchmarking research report—2002. Journal of Air Transport Management, 9(5), 285–297. http://doi.org/10.1016/S0969-6997(03)00037-1

Park, J. W., & Jung, S. Y. (2011). Transfer Passengers' Perceptions of Airport Service Quality: A Case Study of Incheon International Airport. International Business Research, 4(3). http://doi.org/10.5539/ibr.v4n3p75

Rendeiro Martín-Cejas, R. (2006). Tourism service quality begins at the airport. Tourism Management, 27(5), 874–877. http://doi.org/10.1016/j.tourman.2005.05.005

Seida Ardakani, S., Nejatian, M., Farhangnejad, M. A., & Nejati, M. (2015). A fuzzy approach to service quality diagnosis. Marketing Intelligence & Planning, 33(1), 103–119. http://doi.org/10.1108/MIP-02-2013-0035

Skytrax. (2014). Airport Ward Awards. Retrieved June 26, 2015, from http://www.worldairportawards.com/

Sohail, M. S., & Al-Gahtani, A. S. (2005). Measuring service quality at King Fahd International Airport. International Journal of Services and Standards, 1(4), 482–493. http://doi.org/10.1504/IJSS.2005.007473

Tam, M. L., Lam, W., & Lo, H. P. (2010). Incorporating passenger perceived service quality in airport ground access mode choice model. Transportmetrica, 6(1), 3–17. http://doi.org/10.1080/18128600902929583

Tam, M. L., Lam, W., & Lo, H. P. (2011). The Impact of Travel Time Reliability and Perceived Service Quality on Airport Ground Access Mode Choice. Journal of Choice Modelling, 4(2), 49–69. http://doi.org/10.1016/S1755-5345(13)70057-5

Tsai, W.-H., Hsu, W., & Chou, W.-C. (2011). A gap analysis model for improving airport service quality. Total Quality Management & Business Excellence, 22(10), 1025–1040. http://doi.org/10.1080/14783363.2011.611326

Tsaur, S.-H., Chang, T.-Y., & Yen, C.-H. (2002). The evaluation of airline service quality by fuzzy MCDM. Tourism Management, 23(2), 107–115. http://doi.org/10.1016/S0261-5177(01)00050-4

Wang, Y.-M., & Elhag, T. M. S. (2006). Fuzzy TOPSIS method based on alpha level sets with an application to bridge risk assessment. Expert Systems with Applications, 31(2), 309–319. http://doi.org/10.1016/j.eswa.2005.09.040

World Bank. (2013). World Development Indicators: Structure of output. Retrieved May 18, 2015, from http://wdi.worldbank.org/table/4.2#

Xu, Z. (2011). Approaches to multiple attribute group decision making based on intuitionistic fuzzy power aggregation operators. Knowledge-Based Systems, 24(6), 749–760. http://doi.org/10.1016/j.knosys.2011.01.011

Yager, R. R. (2009). On generalized Bonferroni mean operators for multi-criteria aggregation. International Journal of Approximate Reasoning, 50(8), 1279–1286. http://doi.org/10.1016/j.ijar.2009.06.004

Yeh, C.-H., Deng, H., & Chang, Y.-H. (2000). Fuzzy multicriteria analysis for performance evaluation of bus companies. European Journal of Operational Research, 126(3), 459–473. http://doi.org/10.1016/S0377-2217(99)00315-X

Yeh, C. H., & Kuo, Y. L. (2003). Evaluating passenger services of Asia-Pacific international airports. Transportation Research Part E: Logistics and Transportation Review, 39(1), 35–48.

Zadeh, L. A. (1965). Fuzzy sets. Information and Control, 8(3), 338–353.

Zadeh, L. A. (1975). The concept of a linguistic variable and its application to approximate reasoning—I. Information Sciences, 8(3), 199–249. http://doi.org/10.1016/0020-0255(75)90036-5

Zadeh, L. A. (1984). Making computers think like people: The term `fuzzy thinkingÂ¿ is pejorative when applied to humans, but fuzzy logic is an asset to machines in applications from expert systems to process control. IEEE Spectrum, 21(8), 26–32. http://doi.org/10.1109/MSPEC.1984.6370431

Zeleny, M. (1982). Multiple criteria decision making. New York: McGraw-Hill.

Zeleny, M. (1998). Multiple criteria decision making: eight concepts of optimality. Human Systems Management, 17, 97–108.

Zhao, R., & Govind, R. (1991). Algebraic characteristics of extended fuzzy numbers. Information Sciences, 54(1–2), 103–130. http://doi.org/10.1016/0020-0255(91)90047-X

7 Conclusions Limitations and Future research

7.1 General Conclusions

For each of the four papers included in this research, the corresponding conclusion section can be found. In chapter 3, conclusions for the article *Airport Mobile Website Evaluation: Terminal Navigation & Commercial Revenue* (section 3.5, page 81); In chapter 4, for the article *Airport Mobile Internet as an Indication of Innovation* (section 4.6, page 113); In chapter 5, for the article *Airport Surface Access and Mobile Apps* (section 5.5, page 136); and in chapter 6, for the article *Airport Service Quality using Fuzzy numbers and TOPSIS* (section 6.6, page 167).

This section aims to complement those conclusions sections of each article, with a general conclusion of the research that includes the key finding of those papers and the conclusions about the other two objectives defined for the research: Links between academy and industry and the use of technological tools during this research.

The percentage of both, air passengers travelling with smartphone and the percentage of airports providing Internet mobile services to passengers keeps increasing (26% in 2011 and 69% in 2014). Taking into account the evolution observed at the different points in time when this research has been carried out (2011, 2013 y 2014). Therefore, it is expected that in the near future, every passenger will be travelling with an Internet mobile device and every airport will be providing Internet mobile services.

Airports offering Internet mobile services back in 2011 used mostly mobile websites to provide these services. However, during the last three years, at the same time as the mobile operating systems iOS – iPhone – and Android have consolidated in the market, an increasing number of airports have started to provide mobile Apps for these operating systems. Now airports, when providing Internet mobile service, usually have both available (mobile websites and mobile Apps).

The analysis of airports adoption of Internet mobile services bring us to the conclusion that the early adoption is not strongly related to the size of the airports. However, there is a correlation between the early adoption and two variables analyzed, airport commercial revenue and airport's geographical location. North American and European airports are more likely to supply

Internet mobile services and four European airports are founded to be real innovators (London Heathrow, London Stansted, Amsterdam Schiphol y Copenhagen)[24]. The early adoption of mobile services, among others, was one condition to achieve the category of real innovator.

The information that airports provide via those mobile services is not very different from the information passengers find, while navigating the airport terminal building. This is positive because it complements traditional information channels. For instance, one of the Internet mobile services most commonly offered by airports is the information passengers need to board a flight, since the moment they arrive to the airport or even since they leave their offices or homes. This includes ground transport available, terminal number, check-in counter, gate number, etc. Airports, however, are not yet benefiting from the "smart" possibilities of this technology.

In this "smart" direction, airports, in addition to offer useful and complete information that allows passengers to reach the boarding gate (on departure or connecting flights) or the final destination (on arrival flights), can provide value added services that include customized commercial offering, according to the areas where the passengers will pass by on his way to their final destination. One concrete service, related to the airport surface access

[24] The Internet mobile services of each of the four airports identified as real innovators can be founded at the following URLS:
Londres Heathrow:
http://www.heathrow.com/more/mobile-apps
Londres Stansted:
http://www.stanstedairport.com/help-and-advice/stay-up-to-date/mobile-app/
Amsterdam Schiphol
http://www.schiphol.nl/Travellers/FlightInformation/SchipholAppAndMobilewebsite.htm
Copenhague:
https://www.cph.dk/en/flight-info/app/

analyzed on chapter 5, could be to stimulate the use of public transport, while collecting some commercial revenue by selling tickets on those Apps.

The use of mobile technology by air passengers and airports now allows new forms of interaction between both. For instance, Heathrow airport uses actively the social media, Twitter, to communicate with their passengers (see example on Figure 7-1).

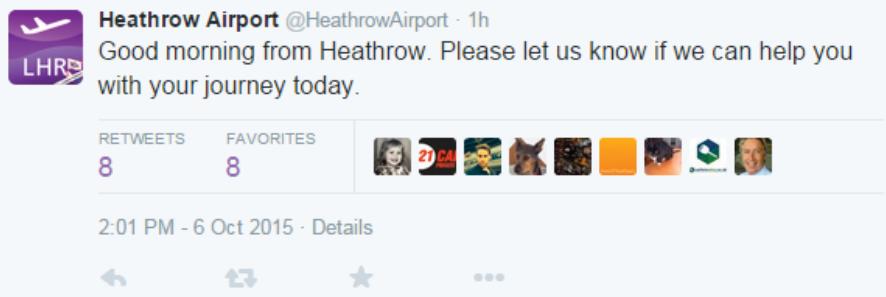

Figure 7-1. Twitter message from London Heathrow airport

Such conversations can contribute to improve airport service quality (ASQ). In addition, these conversations between airports and passengers generate a good amount of data that includes passenger's point of views and opinions about the different services of the airport. Thus, this new interactions can contribute to increase the ASQ, at the same time as to be a rich data source that could be used for research purposes and opening the doors to a new line of ASQ research.

The personal experience of the author in trying to establish links between academia and the airport industry have proved to be very difficult. After establishing, at different points in time of this research, an initial contact with up to five airports (i.e. Manchester - MAN, Frankfurt - FRA, Beijing Capital - PEK, Istanbul Sabiha - SAW and Istanbul Ataturk - IST) interested on the mobile Internet research topic, it was only possible to implement some kind of cooperation with one of them, and almost at the end of this research. Therefore, the potential fruits of that research cooperation between academia and industry cannot be included in this research. At the time of finishing writing this document, the author is waiting for the airport signature of the Non-Disclosure

Agreement (NDA) that was one of the requirements by the airport company to start collaboration.

Taking the author´s experiences on research cooperation with the industry during this research, it is recommended that academia and industry do not collaborate for a single research project, but instead long term relationships and not limited to research. It could include collaboration at different education levels such as internship programs; problem based learning – PBL (Prince & Felder, 2006), where industry propose problems which are solved by students with the support from instructors; and research programs that could involve a PhD student researching on a topic relevant to the industry.

While doing this research, the author coordinated two internship programs: One in Beijing during 2013 with MBA students and the other in Istanbul during 2015 with undergraduate Air Transport Management students. The overall results, for both academia and industry where in general very positive in both situations. Thus, internships programs seem to be also a good way to build and develop cooperation between academia and industry.

For industry-academia research projects at graduate level, based on this research experience, it is recommended always possible to find a counterpart at the industry who has some understanding of academia, at the same time as some degree of decision making within the organization. This double criterion was fulfilled by the counterpart found at the airport for which we are in the process to sign a NDA. For the other four airports, in two of them none of the double criterion was fulfilled by the author's airport contact and in the other two only the academic understanding was available.

The use of blog and video during this research has helped the author to improve his communication skills, while carrying out this research and his lectures. For instance, at the ATRS World conference in Bordeaux in July

2014, it was possible for him to flip[25] his conference presentation by placing a video presentation on his blog that the audience could watch in advance, in order to dedicate the time at the conference to discuss the paper. The article presented then, latter introduced some changes suggested during the discussion and it can now be found in Chapter 5.

This positive experience motivated the author to flip his courses on International Aviation Management and Airline Management at Ozyegin University in Istanbul from February 2015. The evaluation given by students at the end of the semester was positive and he continues using this new instructional strategy.

The knowledge acquired during his research about creating and maintaining a blog, has served the author not only for creating his blog for this research but also during his lectures. Now he has adopted it on his courses and each of his students opens a blog and includes all his assignments and projects for the whole semester.

The author is aware of certain limitations that accompanied this research, which are explained below in section 7.2. Furthermore, the research contributes to the state of the art in various ways that are included in section 7.3. Finally, this research offers a glimpse of some possible lines of future research included in the section 7.4.

7.2 Research Limitations

One important limitation of this research is the fact that the Internet mobile technology changes very quickly and has changed dramatically since this

[25] The term "flip the conference" was borrowed from the term "flip the classroom". In a flipped classroom, students watch online lectures, collaborate in online discussions, or carry out research at home and engage in concepts in the classroom with the guidance of the instructor (Abeysekera & Dawson, 2015)

research started back in 2010. This limitation was partially overcome by splitting the research into separate research papers.

All the databases used for this research included airports from different regions in the world. Although the airport business is similar business across the word, differences can be found between regions and within regions, for instance in the level of adoption of Internet mobile devices.

One single smartphone operating system Apple iOS (using first the iPhone 3 and later the iPhone 5 model) was used to manually collect primary data from the airports mobile websites and Apps. The performance might be different using other smartphones operating systems and models. This fact was evident in Japan, where the evaluation of Narita airport mobile website in 2011 was not possible to be carried out as it only provided the Japanese standard i-mode and could not be viewed on the iPhone device.

The sample of airports used only includes very busy airports (i.e. medium, large and very large airports). mobile Internet seems to be more relevant for larger airports, but the inclusion of smaller airports will better test if the size of airports can explain airport innovativeness. At the same time, it was only possible to analyze three airport characteristics (size, geographical region, and unitary commercial revenue per passenger) in order to explain innovation.

One of this research´s original aims was to combine the mobile Internet services with the ASQ. The plan was to use these mobile Internet services to facilitate the process of ASQ data collection by airports. For example, passengers could access a questionnaire from their mobile devices to streamline the process of making data more accurate. Such a plan could not be carried out because a collaboration agreement with an airport was needed to implement it, and it has not been possible to establish during the period of this research. Finally, the author decided to do some research on ASQ, independent of the use of Internet services for mobile devices, which can contribute to the knowledge of ASQ.

In the research about Airport Quality of Service (ASQ) several limitations must be recognized. To begin with, the database is certainly outdated and all our efforts to obtain more recent data have been, so far, unfruitful. The underlying twenty four attributes used in the analysis might not be a valid scale for the

ASQ construct and other SQ attributes included in the new ACI-ASQ survey could be very important. Hopefully, this drawback could be partly compensated by the large respondents' number that has been used.

The conclusions extracted about developing links between industry and academia are based on a very limited sample (i.e. 5 airports and 2 internship programs). Same applies for the conclusions extracted on the use of technology (i.e. blog and video) during the research. The author is aware of the very limited scientific value of those conclusions; however at the same time the author is convinced that both objectives have contributed to enrich his research and knowledge dissemination skills.

7.3 Research Contribution

The main contribution of this thesis is to enrich the airport management research field by starting a new line of study on the adoption and evaluation of websites, mobile websites and mobile Apps into the airport business; and to analyze how these new services can contribute to overcome some of the challenges airports are facing.

This research has involved the generation of a good amount of primary data about airport websites, mobile websites and mobile Apps. The three snapshots of data (2011, 2013 and 2014) are now available for future research, with a Creative Commons license on an open repository (aeriport.com)

Chapter 4 defines a new innovation model, which is based on the innovation adoption and diffusion theory. This model was successfully applied on this research to find out real innovator airports and could be applied to analyze other innovations adopted by airports as well as any other industry.

The airport surface access problem included on chapter 5 has been extensively investigated. The originality and contribution of this work is the analysis of airport mobile Apps as a potential tool that could help solve this issue.

7.4 Future Research

As the mobile technology and consequently the Internet mobile services provided by airports to passengers changes very quickly, this new line of research offers great opportunities within the field of airport management

research. For instance, one concrete research on this field could be to survey again the same airports used in this research and to analyze future practices.

On this study, both mobile websites and mobile Apps for airports were studied, but both services where not compared with regard to what could be the preferred option for airport passengers. This line of research has been carried out in other fields, as for instance the access to library information (Shun Han Rebekah Wong, 2012) and it is believed to represent an attractive option for future research.

There are other potential variables explaining innovation- different than size, geographical region, and unitary commercial revenue per passenger - that can be analyzed in the future. For example airport networks, importance of low-cost carriers (LCCs), governance, percentage of IT&T budget over total, marketing staff, and R+D staff are other potential variables that could be also analyzed with the intention of getting more thoughtful insights.

Another interesting topic for future research is the analysis of the complementarities of the airports' innovation with all the agents involved in tourism and travel, especially for those destinations that depend very much on air transport, like for example airports in islands. Some guidelines could be obtained from the synergies extracted from the travel and tourism industry in conjunction with the social media, especially Facebook and Twitter. Airports make little use of social networks to communicate marketing campaigns to passengers, and the number of posts is still very low but according to Wattanacharoensil & Schuckert (2015), more attention should be given to this aspect of airport communication. So, this issue could also be used to analyze a third innovation process.

In the area of ASQ it is recommended in the future to disaggregate the attributes in different sets among groups of passengers regarding their profiles and motivation. For example, there will be a need to obtain ASQ indicators regarding departing, arrival or connecting passengers, or business and leisure passengers, or any other profile of interest for airport managers. These aspects seem to be major challenges for the future agenda of research on Airport Service Quality.

Finally, as the trend is that every air passenger will travel with a smartphone in the near future (81% in 2014 according to IATA) and there is an increasing interaction, while travelling, with airports and other travel suppliers via social networks (e.g.: Twitter), there is an opportunity to try to measure their opinion about ASQ by observing the comments they are leaving in those interactions.

8 All References

Aarons, G. A., Hurlburt, M., & Horwitz, S. M. (2010). Advancing a Conceptual Model of Evidence-Based Practice Implementation in Public Service Sectors. *Administration and Policy in Mental Health and Mental Health Services Research*, *38*(1), 4–23. http://doi.org/10.1007/s10488-010-0327-7

Abeysekera, L., & Dawson, P. (2015). Motivation and cognitive load in the flipped classroom: definition, rationale and a call for research. *Higher Education Research & Development*, *34*(1), 1–14. http://doi.org/10.1080/07294360.2014.934336

ACI. (2000). *Airport Council International - Quality of Service at Airport: Standards and Measurements, 1st Edition.*

ACI. (2009). *Top 100 airports worldwide by number of passengers*. Retrieved from http://www.aci.aero/

ACI. (2014). Airport Quality Award 2013. Retrieved June 15, 2015, from http://www.aci.aero/Airport-Service-Quality/ASQ-Awards/Past-Winners/2013

ACI. (2015a). Airport Council International (ACI). Retrieved October 28, 2015, from http://www.aci.aero/About-ACI

ACI. (2015b). ASQ Award Winners 2014. Retrieved June 15, 2015, from http://www.aci.aero/Airport-Service-Quality/ASQ-Awards/Current-Winners

ACI - ASQ. (2015). Airport Council International (ACI) Airport Service Quaility (ASQ). Retrieved October 28, 2015, from http://www.aci.aero/Airport-Service-Quality/ASQ-Home

ACI EUROPE. (2015). ACI EUROPE Membership Programs. Retrieved October 28, 2015, from https://www.aci-europe.org/membership/members-list.html

ACRP. (2015). Airport Cooperative Research Program (ACRP) managed by Transport Research Board (TRB). Retrieved October 7, 2015, from http://www.trb.org/ACRP/ACRP.aspx

Adler, N., Fu, X., Oum, T. H., & Yu, C. (2014). Air transport liberalization and airport slot allocation: The case of the Northeast Asian transport market. *Transportation Research Part A: Policy and Practice*, *62*, 3–19. http://doi.org/10.1016/j.tra.2014.02.003

Aéroports de Paris. (2009). My Airport –Official Aéroports de Paris service. Retrieved June 30, 2014, from https://itunes.apple.com/gb/app/my-airport-the-official-aeroports/id322543617?mt=8

Aéroports de Paris. (2013). My Airport –Official Aéroports de Paris Service. Retrieved May 24, 2014, from https://itunes.apple.com/gb/app/my-airport-the-official-aeroports/id322543617?mt=8

Aéroports de Paris. (2015). My Airport –Official Aéroports de Paris service on the App Store. Retrieved October 28, 2015, from https://itunes.apple.com/app/my-airport-service-officiel/id322543617?mt=8

Airbus. (2014). Global Market Forecast 2014-2033 | Airbus, a leading aircraft manufacturer. Retrieved May 19, 2015, from http://www.airbus.com/company/market/forecast/

android.com. (2012). Apps - Android Market. Retrieved February 2, 2012, from https://market.android.com/

Apple. (2007). Apple Reinvents the Phone with iPhone. Retrieved February 15, 2011, from https://www.apple.com/pr/library/2007/01/09Apple-Reinvents-the-Phone-with-iPhone.html

Apple.com. (2012). Apple - iPhone - Application Store - App Store. Retrieved February 6, 2012, from http://www.apple.com/iphone/apps-for-iphone/

Ashford, N. (1988). Level of service design concept for airport passenger terminals—a European view. *Transportation Planning and Technology*, *12*(1), 5–21. http://doi.org/10.1080/03081068808717356

ATAG. (2014). *Aviation Benefits Beyond Borders - Powering global economic growth, employment, trade links, tourism and support for sustainable development through air transport*. Retrieved from http://aviationbenefits.org/

Athanassopoulos, A. D., & Podinovski, V. V. (1997). Dominance and potential optimality in multiple criteria decision analysis with imprecise information. *Journal of the Operational Research Society*, *48*(2), 142–150.

ATRS. (2014). Global Airport Benchmarking Report. Retrieved from http://atrsworld.org/publications.html

BAA. (2002). *British Airport Authority. BAA (2002). Market Research Group, The Quality of Service Monitor.*

Bai, C., Dhavale, D., & Sarkis, J. (2014). Integrating Fuzzy C-Means and TOPSIS for performance evaluation: An application and comparative analysis. *Expert Systems with Applications*, *41*(9), 4186–4196. http://doi.org/10.1016/j.eswa.2013.12.037

Bai, C., & Sarkis, J. (2013). Green information technology strategic justification and evaluation. *Information Systems Frontiers*, *15*(5), 831–847. http://doi.org/10.1007/s10796-013-9425-x

Benitez, J. M., Martin, J. C., & Roman, C. (2007). Using fuzzy number for measuring quality of service in the hotel industry. *Tourism Management*, *28*(2), 544–555.

Bezerra, G. C. L., & Gomes, C. F. (2015). The effects of service quality dimensions and passenger characteristics on passenger's overall satisfaction with an airport. *Journal of Air Transport Management*, *44–45*, 77–81. http://doi.org/10.1016/j.jairtraman.2015.03.001

Bogicevic, V., Yang, W., Bilgihan, A., & Bujisic, M. (2013). Airport service quality drivers of passenger satisfaction. *Tourism Review*, *68*(4), 3–18. http://doi.org/10.1108/TR-09-2013-0047

Bonferroni, C. (1950). Sulle medie multiple di potenze. *Bollettino dell'Unione Matematica Italiana*, *5*(3-4), 267–270.

Boonruang, S. (2009, November). Bangkok Post : Android looking to take iPhone's crown. Retrieved February 17, 2011, from http://www.bangkokpost.com/tech/computer/28071/android-looking-to-take-iphone-crown

Bracaglia, V., D'Alfonso, T., & Nastasi, A. (2014). Competition between multiproduct airports. *Economics of Transportation*, *3*(4), 270–281. http://doi.org/10.1016/j.ecotra.2015.02.004

Buckley, J. J. (1985). Ranking alternatives using fuzzy numbers. *Fuzzy Sets and Systems*, *15*(1), 21–31. http://doi.org/10.1016/0165-0114(85)90013-2

Budd, T., Ison, S., & Ryley, T. (2011). Airport surface access in the UK: A management perspective. *Research in Transportation Business & Management*, *1*(1), 109–117.

Budd, T., Ryley, T., & Ison, S. (2014). Airport ground access and private car use: a segmentation analysis. *Journal of Transport Geography*, *36*, 106–115. http://doi.org/10.1016/j.jtrangeo.2014.03.012

Budiu, R., & Nielsen, J. (2009). *Usability of Mobile Websites: Research Report with Design Guidelines*. Retrieved from http://www.nngroup.com/reports/mobile/

Buhalis, D., & Law, R. (2008). Progress in information technology and tourism management: 20 years on and 10 years after the Internet–The state of eTourism research. *Tourism Management*, *29*(4), 609–623.

CAA UK. (2009). UK Airport Statistics. Retrieved January 31, 2011, from http://www.caa.co.uk/default.aspx?catid=80&pagetype=88&pageid=3&sglid=3

Changi. (2014). Sıngapore Changi International Airport Awards. Retrieved October 26, 2015, from Source:http://www.changiairport.com/en/aboutus.html?tab=awards-accolades-2014

Chang, Y.-H., & Yeh, C.-H. (2001). Evaluating airline competitiveness using multiattribute decision making. *Omega*, *29*(5), 405–415. http://doi.org/10.1016/S0305-0483(01)00032-9

Chen, S.-J., & Hwang, C.-L. (1992). Fuzzy Multiple Attribute Decision Making Methods. In *Fuzzy Multiple Attribute Decision Making* (pp. 289–486). Springer Berlin Heidelberg. Retrieved from http://link.springer.com/chapter/10.1007/978-3-642-46768-4_5

Chen, S.-M. (1996). Evaluating weapon systems using fuzzy arithmetic operations. *Fuzzy Sets and Systems*, *77*(3), 265–276. http://doi.org/10.1016/0165-0114(95)00096-8

Chiou, W.-C., Lin, C.-C., & Perng, C. (2010). A strategic framework for website evaluation based on a review of the literature from 1995-2006. *Information & Management*, *47*(5-6), 282–290. http://doi.org/doi: DOI: 10.1016/j.im.2010.06.002

Chou, C.-C. (2009). A model for the evaluation of airport service quality. *Proceedings of the ICE - Transport*, *162*(4), 207–213. http://doi.org/10.1680/tran.2009.162.4.207

Chou, C.-C., Liu, L.-J., Huang, S.-F., Yih, J.-M., & Han, T.-C. (2011). An evaluation of airline service quality using the fuzzy weighted SERVQUAL method. *Applied Soft Computing*, *11*(2), 2117–2128. http://doi.org/10.1016/j.asoc.2010.07.010

comScore. (2011). *The 2010 Mobile Year in Review*. Retrieved from http://www.comscore.com/Press_Events/Presentations_Whitepapers/2011/2010_Mobile_Year_in_Review

Coogan, M. A. (2008). *Ground access to major airports by public transportation* (Vol. 4). Transportation Research Board. Retrieved from http://www.google.com/books?hl=en&lr=&id=VD3HXwzpz5IC&oi=fnd&pg=PA1&dq=Coogan,+M.+(2008).+Ground+access+to+major+airports+by+public+transportation,+ACRP+(Airport+Cooperative+Research+Programme)+Report,+4,+Washington,+D.C:+Transportation+Research+Board+of+the+National+Academies.&ots=gHnRHDCyk2&sig=drL5TEGPonvWDIKBEaAdapWuzG4

Correia, A. R., & Wirasinghe, S. C. (2004). Evaluating Level of Service at Airport Passenger Terminals: Review of Research Approaches. *Transportation Research Record: Journal of the Transportation Research Board*, *1888*, 1–6. http://doi.org/10.3141/1888-01

Correia, A. R., & Wirasinghe, S. C. (2007). Development of level of service standards for airport facilities: Application to São Paulo International Airport. *Journal of Air Transport Management*, *13*(2), 97–103. http://doi.org/10.1016/j.jairtraman.2006.10.002

Correia, A. R., & Wirasinghe, S. C. (2010). Level of service analysis for airport baggage claim with a case study of the Calgary International Airport. *Journal of Advanced Transportation*, *44*(2), 103–112. http://doi.org/10.1002/atr.113

Correia, A. R., Wirasinghe, S. C., & de Barros, A. G. (2008). Overall level of service measures for airport passenger terminals. *Transportation Research Part A: Policy and Practice*, *42*(2), 330–346. http://doi.org/10.1016/j.tra.2007.10.009

Damanpour, F. (1991). Organizational innovation: A meta-analysis of effects of determinants and moderators. *The Academy of Management Journal*, *34*(3), 555–590.

Damanpour, F., & Gopalakrishnan, S. (1998). Theories of organizational structure and innovation adoption: the role of environmental change. *Journal of Engineering and Technology Management*, *15*(1), 1–24. http://doi.org/10.1016/S0923-4748(97)00029-5

Damanpour, F., & Schneider, M. (2009). Characteristics of Innovation and Innovation Adoption in Public Organizations: Assessing the Role of Managers. *Journal of Public Administration Research and Theory*, *19*(3), 495–522. http://doi.org/10.1093/jopart/mun021

DFW. (2009). DFW International Airport Debuts Mobile Web Site. Retrieved September 8, 2014, from http://www.dfwairport.com/pressroom/Debuts_Mobile_Web_Site.pdf

Distimo.com. (2011). Total Number of Smartphone Applications. Retrieved June 11, 2011, from http://www.distimo.com/blog/2011_01_distimo-releases-full-year-2010-report/

Dyer, J. S., & Sarin, R. K. (1979). Measurable Multiattribute Value Functions. *Operations Research*, *27*(4), 810–822. http://doi.org/10.1287/opre.27.4.810

Erdil, S. T., & Yıldız, O. (2011). Measuring service quality and a comparative analysis in the passenger carriage of airline industry. *Procedia - Social and Behavioral Sciences*, *24*, 1232–1242. http://doi.org/10.1016/j.sbspro.2011.09.117

EU Research. (2006). *Mobility of researchers between academia and industry*. Retrieved from http://ec.europa.eu/euraxess/pdf/research_policies/mobility_of_researchers_light.pdf

eyeforTravelResearch. (2009). *The School of Mobile: Mobile Technology in Travel* (No. volumen 1). Retrieved from http://www.eyefortravel.com/reports

Facebook. (2011). Mobile Internet Users. Retrieved May 25, 2011, from http://www.facebook.com

Fernandes, E., & Pacheco, R. R. (2008). A quality approach to airport management. *Quality & Quantity*, *44*(3), 551–564. http://doi.org/10.1007/s11135-008-9212-9

Fodness, D., & Murray, B. (2007). Passengers' expectations of airport service quality. *Journal of Services Marketing*, *21*(7), 492–506. http://doi.org/10.1108/08876040710824852

Frambach, R. T., & Schillewaert, N. (2002). Organizational innovation adoption: a multi-level framework of determinants and opportunities for future research. *Journal of Business Research*, *55*(2), 163–176. http://doi.org/doi: DOI: 10.1016/S0148-2963(00)00152-1

Freixas, X., Guesnerie, R., & Tirole, J. (1985). Planning under Incomplete Information and the Ratchet Effect. *The Review of Economic Studies*, *52*(2), 173–191. http://doi.org/10.2307/2297615

Gillen, D., & Lall, A. (2002). The economics of the Internet, the new economy and opportunities for airports. *Journal of Air Transport Management*, *8*(1), 49–62. http://doi.org/doi: DOI: 10.1016/S0969-6997(01)00041-2

Graham, A. (2009). How important are commercial revenues to today's airports? *Journal of Air Transport Management*, *15*(3), 106–111. http://doi.org/doi: DOI: 10.1016/j.jairtraman.2008.11.004

Graham, A. (2013). *Managing airports: an international perspective*. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&scope=site&db=nlebk&db=nlabk&AN=652617

Greenhalgh, T., Robert, G., Macfarlane, F., Bate, P., & Kyriakidou, O. (2004). Diffusion of Innovations in Service Organizations: Systematic Review and Recommendations. *The Milbank Quarterly*, *82*(4), 581–629. http://doi.org/10.1111/j.0887-378X.2004.00325.x

Gupta, A., Arif, M., & Richardson, P. (2014). Assessing Customer Service in Airports – Models from the UAE. *International Journal of Aviation, Aeronautics, and Aerospace*, *1*(2). http://doi.org/10.15394/ijaaa.2014.1007

Halpern, N., & Graham, A. (2013). *Airport marketing*. New York: Routledge. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&scope=site&db=nlebk&db=nlabk&AN=601494

Halpern, N., & Regmi, U. K. (2013). Content analysis of European airport websites. *Journal of Air Transport Management*, *26*, 8–13. http://doi.org/10.1016/j.jairtraman.2012.08.006

Han, S., Ham, S. (Sunny), Yang, I., & Baek, S. (2012). Passengers' perceptions of airline lounges: Importance of attributes that determine usage and service quality measurement. *Tourism Management*, *33*(5), 1103–1111. http://doi.org/10.1016/j.tourman.2011.11.023

Heathrow Airport. (2014). Heathrow Airport Guide. Retrieved July 3, 2014, from https://itunes.apple.com/gb/app/heathrow-airport-guide/id427951859?mt=8

Ho, C.-I., & Lee, Y.-L. (2007). The development of an e-travel service quality scale. *Tourism Management*, *28*(6), 1434–1449. http://doi.org/doi: DOI: 10.1016/j.tourman.2006.12.002

Hwang, C. L., & Yoon, K. (1981). *Multiple attribute decision making: methods and applications : a state-of-the-art survey*. Berlin; New York: Springer-Verlag.

IATA. (2000). *International Air Transport Association - IATA Global Airport Monitoring 2000.*

IATA. (2015). Aim of the International Air Transport Association (IATA). Retrieved October 28, 2015, from http://www.iata.org/about/Pages/index.aspx

Ibrahim, H. (2011). Assessing service quality within airport industry. *TECNIAJournal of Management Studies*, 1.

IDC. (2014). Smartphone OS Market Share. Retrieved June 1, 2014, from http://www.idc.com/prodserv/smartphone-os-market-share.jsp

IDPF. (2015). IDPF - International Digital Pubish Forum. Retrieved October 1, 2015, from http://idpf.org/epub

Internet Worldstats. (2015). Interent World Statistics. Retrieved from http://www.internetworldstats.com/stats.htm

Janic, M. (2003). Assessment and Management of Quality of Service at an Airport Passenger Terminal. *Transportation Planning and Technology*, *26*(3), 239–263. http://doi.org/10.1080/03081060320001544601

Kabir, G., & Sumi, R. S. (2013). Evaluation of Travel Website Service Quality Using Fuzzy Topsis. *Suranaree Journal of Science & Technology*, *20*(1), 21–33.

Kaufmann, A., & Gupta, M. M. (1988). *Fuzzy mathematical models in engineering and management science*. Amsterdam; New York; New York, N.Y., U.S.A.: North-Holland ; Sole distributors for the U.S.A. and Canada, Elsevier Science Pub. Co.

Kaur, S. (2013). The Revolution of Tablet Computers and Apps: A Look At Emerging Trends. *IEEE Consumer Electronics Magazine*, *2*(1), 36–41. http://doi.org/10.1109/MCE.2012.2223371

Keeney, R. L., & Raiffa, H. (1993). *Decisions with Multiple Objectives: Preferences and Value Trade-Offs*. Cambridge University Press.

Kim, J., Lee, I., Lee, Y., Choi, B., Hong, S. J., Tam, K., … Maeda, Y. (2004). Exploring e-business implications of the mobile internet: a cross-national survey in Hong Kong, Japan and Korea. *International Journal of Mobile Communications*, *2*(1), 1–21.

Kumar, V., Ganesh, J., & Echambadi, R. (1998). Cross-National Diffusion Research: What Do We Know and How Certain Are We? *Journal of Product Innovation Management*, *15*(3), 255–268.

Kuo, M.-S., & Liang, G.-S. (2011). Combining VIKOR with GRA techniques to evaluate service quality of airports under fuzzy environment. *Expert Systems with Applications*, *38*(3), 1304–1312. http://doi.org/10.1016/j.eswa.2010.07.003

Laffont, J.-J., & Tirole, J. (1988). The Dynamics of Incentive Contracts. *Econometrica*, *56*(5), 1153–1175. http://doi.org/10.2307/1911362

Law, R., Qi, S., & Buhalis, D. (2010). Progress in tourism management: A review of website evaluation in tourism research. *Tourism Management*, *31*(3), 297–313.

Lee, G., & Xia, W. (2006). Organizational size and IT innovation adoption: A meta-analysis. *Information & Management*, *43*(8), 975–985.

Léopold, E. (2009). The future of mobile check-in. *Journal of Airport Management*, *3*(3), 215–222.

Liébana-Cabanillas, F., Sánchez-Fernández, J., & Muñoz-Leiva, F. (2014). The moderating effect of experience in the adoption of mobile payment tools in Virtual Social Networks: The m-Payment Acceptance Model in Virtual Social Networks (MPAM-VSN). *International Journal of Information Management*, *34*(2), 151–166. http://doi.org/10.1016/j.ijinfomgt.2013.12.006

Lin, H.-F. (2010). An application of fuzzy AHP for evaluating course website quality. *Computers & Education*, *54*(4), 877–888. http://doi.org/10.1016/j.compedu.2009.09.017

Liou, J. J. H., Tang, C.-H., Yeh, W.-C., & Tsai, C.-Y. (2011). A decision rules approach for improvement of airport service quality. *Expert Systems with Applications*, *38*(11), 13723–13730. http://doi.org/10.1016/j.eswa.2011.04.168

Lubbe, B. (2007). The effect of Internet apprehension and website satisfaction on air travellers' adoption of an airline's website. *Journal of Air Transport Management*, *13*(2), 75–80.

Lubbe, B., Douglas, A., & Zambellis, J. (2011). An application of the airport service quality model in South Africa. *Journal of Air Transport Management*, *17*(4), 224–227. http://doi.org/10.1016/j.jairtraman.2010.08.001

Lupo, T. (2015). Fuzzy ServPerf model combined with ELECTRE III to comparatively evaluate service quality of international airports in Sicily. *Journal of Air Transport Management*, *42*, 249–259. http://doi.org/10.1016/j.jairtraman.2014.11.006

Mamdani, E. H., & Assilian, S. (1975). An experiment in linguistic synthesis with a fuzzy logic controller. *International Journal of Man-Machine Studies*, *7*(1), 1–13. http://doi.org/10.1016/S0020-7373(75)80002-2

Manataki, I. E., & Zografos, K. G. (2009). A generic system dynamics based tool for airport terminal performance analysis. *Transportation Research Part C: Emerging Technologies*, *17*(4), 428–443. http://doi.org/doi: DOI: 10.1016/j.trc.2009.02.001

Marsden, G. R., Kamal, P., & Muir, H. (2006). Kiss and Fly-a study of the impacts at a UK regional airport. Retrieved from http://eprints.whiterose.ac.uk/42630/

Martín-Domingo, L., Adiloglu, L., Erturk, M., & Peksatici, O. N. (2015). Istnbul Hub Seminar: How Istanbul plans to become a major aviation center? Retrieved October 18, 2015, from https://eresearchm.ozyegin.edu.tr/xmlui/handle/10679/924

Martín, J. C., Román, C., & Voltes-Dorta, A. (2009). A stochastic frontier analysis to estimate the relative efficiency of Spanish airports. *Journal of Productivity Analysis*, *31*(3), 163–176. http://doi.org/10.1007/s11123-008-0126-2

Merkert, R., & Assaf, A. G. (2015). Using DEA models to jointly estimate service quality perception and profitability – Evidence from international airports. *Transportation Research Part A: Policy and Practice*, *75*, 42–50. http://doi.org/10.1016/j.tra.2015.03.008

Miniwats. (2011). Internet World Statistics. Retrieved October 15, 2010, from http://www.internetworldstats.com/stats.htm

Min, J., & Peng, K.-H. (2012). Ranking emotional intelligence training needs in tour leaders: an entropy-based TOPSIS approach. *Current Issues in Tourism*, *15*(6), 563–576. http://doi.org/10.1080/13683500.2011.641946

Miyoshi, C., & Mason, K. J. (2013). The damage cost of carbon dioxide emissions produced by passengers on airport surface access: the case of Manchester Airport. *Journal of Transport Geography*, *28*, 137–143. http://doi.org/10.1016/j.jtrangeo.2012.12.003

Moneyterms. (2015). RPK (Revenue Passenger Kilometres). Retrieved October 28, 2015, from http://moneyterms.co.uk/rpk-revenue-passenger-kilometres/

Müller, C., & Gosling, G. D. (1991). A framework for evaluating level of service for airport terminals. *Transportation Planning and Technology*, *16*(1), 45–61. http://doi.org/10.1080/03081069108717470

Munneke, M. (2014). *The Moodie Report´s e-Zine - The airport app of the future* (No. 138) (pp. 28–29). Retrieved from http://edition.pagesuite-professional.co.uk/Launch.aspx?EID=3fe80105-f49b-439a-966a-4661567eb368

Nielsen, J. (2009). Mobile Web 2009 = Desktop Web 1998 (Jakob Nielsen's Alertbox). Retrieved February 17, 2011, from http://www.useit.com/alertbox/mobile-2009.html

Ohri, M. (2009). Discussion Paper: Airport Privatization in India. *Networks and Spatial Economics*, *12*(2), 279–297. http://doi.org/10.1007/s11067-009-9117-8

Okazaki, S. (2006). What do we know about mobile Internet adopters? A cluster analysis. *Information & Management*, *43*(2), 127–141. http://doi.org/doi: DOI: 10.1016/j.im.2005.05.001

Okazaki, S., & Hirose, M. (2009). Does gender affect media choice in travel information search? On the use of mobile Internet. *Tourism Management*, *30*(6), 794–804. http://doi.org/doi: DOI: 10.1016/j.tourman.2008.12.012

Orange. (2010). *Mobile Exposure 2010*. Retrieved from http://exposure2010.orangeadvertisingnetwork.co.uk/pdf/Consumer-Orange-Exposure-English-FINAL.pdf

Orfila-Sintes, F., Crespo-Cladera, R., & Martinez-Ros, E. (2005). Innovation activity in the hotel industry: Evidence from Balearic Islands. *Tourism Management*, *26*(6), 851–865. http://doi.org/doi: DOI: 10.1016/j.tourman.2004.05.005

Oum, T. H., Yu, C., & Fu, X. (2003). A comparative analysis of productivity performance of the world's major airports: summary report of the ATRS global airport benchmarking

research report—2002. *Journal of Air Transport Management*, *9*(5), 285–297. http://doi.org/10.1016/S0969-6997(03)00037-1

Park, J. W., & Jung, S. Y. (2011). Transfer Passengers' Perceptions of Airport Service Quality: A Case Study of Incheon International Airport. *International Business Research*, *4*(3). http://doi.org/10.5539/ibr.v4n3p75

Park, Y. A., & Gretzel, U. (2007). Success factors for destination marketing web sites: A qualitative meta-analysis. *Journal of Travel Research*, *46*(1), 46.

Pedersen, P. E., & Ling, R. (2003). Modifying adoption research for mobile Internet service adoption: Cross-disciplinary interactions. In *Proceding 36th Hawaii International Conference on System Sciences*.

Perez, S. (2014). iTunes App Store Now Has 1.2 Million Apps, Has Seen 75 Billion Downloads To Date. Retrieved June 30, 2014, from http://techcrunch.com/2014/06/02/itunes-app-store-now-has-1-2-million-apps-has-seen-75-billion-downloads-to-date/

Prince, M. J., & Felder, R. M. (2006). Inductive teaching and learning methods: Definitions, comparisons, and research bases. *JOURNAL OF ENGINEERING EDUCATION-WASHINGTON-*, *95*(2), 123.

Rendeiro Martín-Cejas, R. (2006). Tourism service quality begins at the airport. *Tourism Management*, *27*(5), 874–877. http://doi.org/10.1016/j.tourman.2005.05.005

Rogers, E. M. (1995). *Diffusion of innovations*. The Free Press.

Ryanair. (2009). Annual Report. Retrieved January 31, 2011, from http://www.ryanair.com/en

Ryley, T., Elmirghani, J., Budd, T., Miyoshi, C., Mason, K., Moxon, R., … Zanni, A. (2013). Sustainable Development and Airport Surface Access: The Role of Technological Innovation and Behavioral Change. *Sustainability*, *5*(4), 1617–1631.

Scolari, C. A., & Fernández-Cavia, J. (2014). Mobile Applications and Destination Branding in Spain. *International Journal of Interactive Mobile Technologies (iJIM)*. Retrieved from http://online-journals.org/index.php/i-jim/article/view/3575

Seida Ardakani, S., Nejatian, M., Farhangnejad, M. A., & Nejati, M. (2015). A fuzzy approach to service quality diagnosis. *Marketing Intelligence & Planning*, *33*(1), 103–119. http://doi.org/10.1108/MIP-02-2013-0035

Shun Han Rebekah Wong. (2012). Which platform do our users prefer: website or mobile app?null. *Reference Services Review*, *40*(1), 103–115. http://doi.org/10.1108/00907321211203667

SITA. (2012). *Passenger Self-Service Survey 2012 | SITA.aero*. Retrieved from http://www.sita.aero/surveys-reports/industry-surveys-reports/passenger-self-service-survey-2012

SITA. (2013). *Passenger IT Trends Survey 2013 | SITA.aero*. Retrieved from http://www.sita.aero/surveys-reports/industry-surveys-reports/passenger-it-trends-survey-2013

SITA. (2014a). *Airport IT Trends Survey 2014*. Retrieved from http://www.sita.aero/surveys-reports/industry-surveys-reports/airport-it-trends-survey-2014

SITA. (2014b). *The passenger IT Trends Survey 2014 | SITA.aero*. Retrieved from http://www.sita.aero/resources/type/surveys-reports/passenger-it-trends-survey-2014

SITA. (2015). *The passenger IT Trends 2015*. Retrieved from http://www.sita.aero/resources/type/surveys-reports/passenger-it-trends-survey-2015

Skytrax. (2014). Airport Ward Awards. Retrieved June 26, 2015, from http://www.worldairportawards.com/

Sohail, M. S., & Al-Gahtani, A. S. (2005). Measuring service quality at King Fahd International Airport. *International Journal of Services and Standards*, *1*(4), 482–493. http://doi.org/10.1504/IJSS.2005.007473

Solomons, N. M., & Spross, J. A. (2011). Evidence-based practice barriers and facilitators from a continuous quality improvement perspective: an integrative review. *Journal of Nursing Management*, *19*(1), 109–120. http://doi.org/10.1111/j.1365-2834.2010.01144.x

statcounter.com. (2011). Top 8 Mobile Operating Systems in Apr 2011. Retrieved June 7, 2011, from http://gs.statcounter.com/#mobile_os-ww-monthly-201005-201105

Tam, M. L., Lam, W., & Lo, H. P. (2010). Incorporating passenger perceived service quality in airport ground access mode choice model. *Transportmetrica*, *6*(1), 3–17. http://doi.org/10.1080/18128600902929583

Tam, M. L., Lam, W., & Lo, H. P. (2011). The Impact of Travel Time Reliability and Perceived Service Quality on Airport Ground Access Mode Choice. *Journal of Choice Modelling*, *4*(2), 49–69. http://doi.org/10.1016/S1755-5345(13)70057-5

Tornatzky, L. G., & Klein, K. J. (1982). Innovation characteristics and innovation adoption-implementation: A meta-analysis of findings. *IEEE Transactions on Engineering Management*, *29*(1), 28–45.

Tsai, W.-H., Hsu, W., & Chou, W.-C. (2011). A gap analysis model for improving airport service quality. *Total Quality Management & Business Excellence*, *22*(10), 1025–1040. http://doi.org/10.1080/14783363.2011.611326

Tsaur, S.-H., Chang, T.-Y., & Yen, C.-H. (2002). The evaluation of airline service quality by fuzzy MCDM. *Tourism Management*, *23*(2), 107–115. http://doi.org/10.1016/S0261-5177(01)00050-4

Vueling. (2009). Annual Report. Retrieved January 31, 2011, from http://www.vueling.com/

W3C.org. (2011). Usability - ISO 9241 definition. Retrieved February 16, 2011, from http://www.w3.org/2002/Talks/0104-usabilityprocess/slide3-0.html

Wang, Y.-M., & Elhag, T. M. S. (2006). Fuzzy TOPSIS method based on alpha level sets with an application to bridge risk assessment. *Expert Systems with Applications*, *31*(2), 309–319. http://doi.org/10.1016/j.eswa.2005.09.040

Wattanacharoensil, W., & Schuckert, M. (2015). How Global Airports Engage Social Media Users: A Study of Facebook use and its Role in Stakeholder Communication. *Journal of Travel & Tourism Marketing*, *32*(6), 656–676. http://doi.org/10.1080/10548408.2014.955245

World Bank. (2013). World Development Indicators: Structure of output. Retrieved May 18, 2015, from http://wdi.worldbank.org/table/4.2#

Xu, Z. (2011). Approaches to multiple attribute group decision making based on intuitionistic fuzzy power aggregation operators. *Knowledge-Based Systems*, *24*(6), 749–760. http://doi.org/10.1016/j.knosys.2011.01.011

Yager, R. R. (2009). On generalized Bonferroni mean operators for multi-criteria aggregation. *International Journal of Approximate Reasoning*, *50*(8), 1279–1286. http://doi.org/10.1016/j.ijar.2009.06.004

Yeh, C.-H., Deng, H., & Chang, Y.-H. (2000). Fuzzy multicriteria analysis for performance evaluation of bus companies. *European Journal of Operational Research*, *126*(3), 459–473. http://doi.org/10.1016/S0377-2217(99)00315-X

Yeh, C. H., & Kuo, Y. L. (2003). Evaluating passenger services of Asia-Pacific international airports. *Transportation Research Part E: Logistics and Transportation Review*, *39*(1), 35–48.

Zadeh, L. A. (1965). Fuzzy sets. *Information and Control*, *8*(3), 338–353.

Zadeh, L. A. (1975). The concept of a linguistic variable and its application to approximate reasoning—I. *Information Sciences*, *8*(3), 199–249. http://doi.org/10.1016/0020-0255(75)90036-5

Zadeh, L. A. (1984). Making computers think like people: The term `fuzzy thinkingÂ¿ is pejorative when applied to humans, but fuzzy logic is an asset to machines in applications from expert systems to process control. *IEEE Spectrum*, *21*(8), 26–32. http://doi.org/10.1109/MSPEC.1984.6370431

Zeleny, M. (1982). *Multiple criteria decision making*. New York: McGraw-Hill.

Zeleny, M. (1998). Multiple criteria decision making: eight concepts of optimality. *Human Systems Management*, *17*, 97–108.

Zhao, R., & Govind, R. (1991). Algebraic characteristics of extended fuzzy numbers. *Information Sciences*, *54*(1–2), 103–130. http://doi.org/10.1016/0020-0255(91)90047-X