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Airport Mobile Internet as an Indicator of Innovation: Theoretical Model

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1. Introduction

Commercial airports have an increasing pressure from both, its customer airlines to keep competitive prices and from its shareholders to be profitable. One way for airport 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 much more challenging to develop commercial revenue by airports (Graham, 2009: 1). 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 goal.

Mobile Internet started to be used in Japan in the late 90's and gained popularity in the travel information search in the late 2000's (Okazaki et al, 2009: 795). The year 2009 saw some of the first airports adopting mobile Internet services as for example Dallas Fort Worth International airport in the USA (dfwairport.com, 2009). Orfila-Sintes et al. (2005) defines innovation as "the conversion of technological knowledge into new services introduced in the market". Thus, the adoption of airport mobile Internet is an innovation and could serve as an indicator of innovation to overcome the airport commercial challenges.

The main objective of this study is, using innovation theory to build a model that helps to find out if mobile Internet adoption is a clear sign of airport innovation

This document contains in section 2 some background on airport commercial revenue and mobile Internet as an innovation for airports. In section 3, a literature review on innovation adoption and innovation diffusion theory is presented. In section 4, a theoretical model, using innovation theory is defined. The model aims to find out if airports early adopters of mobile Internet can be considered real innovators. Last, in section 5 the conclusions are presented and the implications and limitations are included.

2. Background

2.1. Airport Commercial Revenue

Historically, publicly owned airports have been treated as "Public Utilities", with public service obligations (Doganis, 1992). Consequently, the economic

performance of airports was not given top priority. However, with a widespread airline privatization and commercialization, progress toward airport commercialization and economic performance has grown in importance. Increasingly airports are real enterprises, their goal being long-term profit generation (Jiang, 2006).

The two main sources of revenue of commercial airports are: Aeronautical revenue and commercial revenue (Perng et al., 2010: 279). The former comes from passenger and airline fees, the latter is been generated from services offered by the airport and third parties, as for instance retail. According to the Airport Council International (ACI) annual world airport economic surveys of over 650 airports of varying sizes, commercial revenues accounted for 48% of total revenue in 2006 (Graham, 2009: 1). Thus, commercial revenue is an important part of the airport's economics.

Development of commercial revenues at airports has been highly dependant on two key factors. First, the evolution of the airport sector from a public utility to a commercialized, and in some cases privatized industry, has given airports greater freedom, expertise and motivation to exploit the commercial opportunities; and second, there has been increasing pressure from the airline industry for airports to control their aeronautical revenue and give them reason to develop commercial revenues (Graham, 2009: 1). The development of commercial revenue permits airports: i) To reward its shareholders (at private airports) or to avoid public subsidies (at public airports); and ii) To provide competitive fees to its customer airlines.

One way, for the now mature commercial airports, to develop commercial revenue in the past was to increase retailing space. For example in the UK, BAA airports expanded its retail space from 40,000 m2 in 1990 to over 100,000 m2 in 2008 - excluding terminal 5 at Heathrow (Graham, 2009: 5). However, such increase should be within certain limits. Large amounts of commercial space per passenger is associated with lower commercial revenue per square meter, confirming decreasing marginal revenue effects (Fuerst et al., 2011: 278).

Graham (2009) points out several challenges that airports face to develop commercial revenue: Consumer trends, security development and political changes. Airports will find difficult to have a pro-active approach towards some of those challenges (i.e. security and political changes). However, airports can observe consumer trends in order to adapt the actual services or even create new ones. One increasing trend is the use of Internet by

passengers and a more recent one, the access to Internet from mobile devices.

2.2. Airport Mobile Internet

Internet has changed the way of doing business in the tourism industry (Ho et al., 2007: 1,434) and, the number of Internet users keeps growing having reached high penetration rates in developed countries. For instance, 77.4% of people in North America used the Internet in 2010 (Miniwats, 2011).

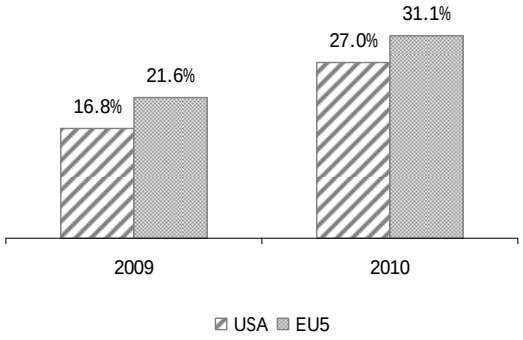
The Air Transport Industry has been specially influenced by Internet. Now, many air passengers use the Internet to book an airline ticket, to check-in before their flight or to book airport parking space. For instance, 60% of passengers flying with the Spanish airline Vueling during 2009 booked their tickets at the Internet (Vueling, 2009). The percentage of passengers went up to 99% in the case of the Irish airline (Ryanair, 2009). The actual percentage of travelers using Internet to check-in in 2010 was 53.4% and up to 65% would have preferred to use Internet to check-in their flights (Rose, 2011: 10). Thus, the Internet is more and more present for air travelers.

Most airports have now websites, but those webs are not always present in traveler's minds. As Gillen et. al., (2002) pointed out airports and airport websites are often an afterthought in the travel industry. Now however, airport websites tend to have rich content with some dynamic features. For instance, a common functionality offered by airport websites is the flight status where it is possible to check online flight status (i.e. Terminal number, time of departure, gate number, etc.). In addition, most of airports websites include extensive information on how to commute to and from the airport.

Traditionally, the way to access Internet has been from a computer (PC Internet). However, now the access to the Internet is also extended to the mobile phone (Mobile Internet). The mobile device used to access the Internet is commonly called Smartphone. The penetration rate of these devices is growing rapidly. For example, 27% of mobile phone users in the USA had a smartphone at the end of 2010, in EU5[1] the penetration was even larger with a 31.1% (comScore, 2011). Both markets increased penetration rates by around 10 percentage units from December 2009 to December 2010 (see Figure 1).

[1] EU5 includes France, Germany, Italy, Spain and the UK.

Figure 1 – Smartphone Penetration by Market



Source: (comScore, 2011)
EU5 includes France, Germany, Italy, Spain and the UK

The increase in number of smartphones is also reflected in the number of people accessing information from their mobile devices. For instance, during March 2011 the social network Facebook had over 600 million of total users and 250 million accessed it from a mobile device. This figure of mobile users represents 10 times the figure Facebook reached only two years before (Facebook, 2011). Thus, not only more people are having mobile phones with access to the Internet, but also more people are accessing Internet on the move.

The information and services provided at airport's mobile platforms can help passengers while navigating at the airport in their way to board their flights. For instance, passengers providing their flight number through their mobile devices, could get in exchange customized information of its flight boarding gate, number and boarding time. Thus, these services could prevent passengers in searching for such information at airport information panels. Customization and convenience of the information will result in better services and, very likely, in greater spend at airport shops and restaurants (Rose, 2011: 14). Thus commercial revenue will have a positive impact.

3. Literature Review

This section includes the literature review on innovation diffusion and adoption applied to organizations. The diffusion of Innovation book (Rogers,

1995) represents a key bibliography, both in the review and in the model defined in Section 4.

3.1. Definition of innovation

"An innovation is an idea, practice, or object that is perceived as new by an individual or other unit of adoption" (Rogers, 1995: 43). This paper aims to apply the innovation theory to airports. Thus, from Roger's definition, we will interpret "the other unit of adoption" as "organization".

When referring to innovations adopted by organizations, Damanpour et al. (1998) defined innovation as "the adoption of an idea or behavior new to the organization". Innovation adopted by organizations is the scope of this paper, in particular airport organizations – which belong to the service industry.

The innovation on the use of mobile Internet can be classified as a technological innovation (Buhalis & Law, 2008: 615). A definition of a technological innovation adopted by service organizations was given by Orfila-Sintes et al. (2005: 852):

> "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".

Now, we can apply the above definition to the use of mobile Internet by airports. The technological knowledge can be divided into two parts: 1) The technological knowledge of airports processing and guiding passengers through the airport terminal building (already available); and 2) The technological knowledge of mobile Internet (might or might not be available). By combining 1) and 2) airports are starting to provide a new service to the market. Thus, airport mobile Internet can be considered as an innovation.

3.2. Diffusion and Adoption of Innovation

Diffusion is defined as "the process by which an innovation is communicated through certain channels over time among the members of a social system" (Rogers, 1995: 18). During this process organization members become aware of the innovation and decide whether to adopt it.

The adoption of innovation is generally intended to contribute to the performance or effectiveness of the adopting organization (Damanpour, 1991: 556). It refers to the point in time when the innovation is adopted by the

organization in relation to other organizations (e.g. competitors or other industry members).

The main difference between diffusion and adoption theory 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 et al., 2003: 2-3).

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 airports early adopters of mobile Internet.

3.3. Attributes of Innovations and its Rate of Adoption

"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: 177). It is also defined as the speed with which the organization adopts innovation after the first introduction elsewhere. It reflects the organization's responsiveness and its ability to adopt innovation quickly relative to its competitors within the industry (Damanpour et al., 1998: 4). The rate of adoption is generally measured as the number of organizations who adopt a new idea in a specific period, such as a year (Rogers 1995: 177).

Some innovations are adopted much faster than others and it is relevant to know what the main characteristics under these different patterns are. Frambach et. al. (2002) points out that the perception of an innovation by members of an organization affects their evaluation and propensity to adopt the innovation. The perceived attributes or characteristics of the innovation are one of the most important explanations of the rate of adoption of an innovation (Rogers 1995: 177).

Tornatzky et al. (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: 127) points out that mobile Internet seems to satisfy the five attributes used by Roger.

Thus, in this paper, we use the five attributes defined by Rogers (1995) in order to analyze the adoption of internet mobile as an innovation in the industry with special emphasis for a departing passenger at the terminal building.

a) *Relative advantage: is the degree to which an innovation is perceived as being better than the idea it supersedes.*

   Most airports provide flight information panels to guide passengers throughout the terminal. Panels include gate number, boarding time and flight status information. Same type of information can be provided at a mobile platform. The advantage for the airport would be that flight information could be personalized to each passenger (i.e. only information related to the flight the passenger is taken), the service is available anywhere in the terminal (i.e. not necessary to check the information panels), and the service could provide additional personalized information (e.g. Eating and shopping possibilities customized to each passenger in their way to the gate).

b) *Compatibility: is the degree to which an innovation is perceived as being consistent with the existing values, past experiences, and needs of potential adopters.*

   Airports can provide flight information at its mobile Internet website or application at the same time as they provide it at the physical information panels of the airport.

c) *Complexity: is the degree to which an innovation is perceived as difficult to understand and use.*

   Airports have provided flight information at its PC website for period of time now. Thus, incorporating the same information on a mobile platform should not be complex. A bit more complex will be to provide new features (e.g. using mobile services to guide passengers thought the terminal building).

d) *Trialability: is the degree to which an innovation may be experimented with on a limited basis.*

Airports can provide mobile services which are already available at its PC-website. Thus, the investment and development required to try such a new service should be limited.

e) *Observability: is the degree to which the results of an innovation are visible to others.*

Airports providing a mobile website or mobile application can be observed from any mobile phone compatible with the mobile service provided. One example is the author while carrying out this research, access airport mobile websites from all over the world, while seating at the laboratory.

In addition, passengers at the terminal building accessing the airport mobile website or application can be easy observed by other passengers. Airports employees deciding on the internet adoption are also passengers themselves at different airports and can observe as well.

We mentioned before that the attributes of an innovation (in the eyes of adopters) can help to explain and estimate the innovation rate of adoption. In addition, attributes can be used to compare different innovations (Rogers, 1995: 178).

3.4. Adoption and Implementation

An organization decision to adopt and implement an innovation does not happen overnight, this is a process. As Damanpour et al. (1998) points out, for the adopting organization, the innovation process includes the following stages: i) Awareness of innovation; ii) Attitude formation; iii) Evaluation; iv) Decision to adopt; v) Trial implementation and; vi) Sustained implementation.

The innovation process consists of different stages. However, a critic to the innovation diffusion research is that often only focus on the dichotomous adoption/non-adoption decision (Frambach et al., 2002: 164), (Tornatzky et al., 1982: 2). Tornatzky et al. (1982) suggests that it should focus on both, adoption and implementation of the innovation.

The degree of implementation of an innovation after the innovation has been adopted uses different names. For instance, Rogers (1995) calls re-invention

the fact that some innovations are not adopted exactly the same and evolve over time. Re-invention is defined as the degree to which an innovation is changed or modified by a user in the process of its adoption and implementation (Rogers, 1995: 304).

In the adoption of mobile Internet by airports, we can define the adoption as the point in time that an airport first provides to its passengers a mobile service. The degree of implementation could be measured by the number of mobile platforms provided at any point in time, after the innovation was adopted.

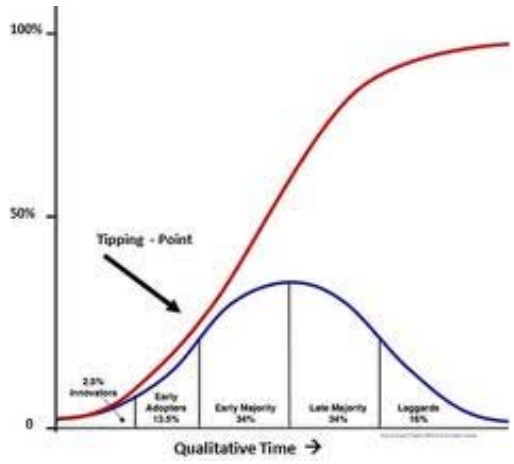
3.5. Innovativeness and Adopter Categories

The concept of innovativeness and adopter categories, based on the S-shaped curve of adoption, was taken from Rogers (1995). Roger defines the below concepts with evidence from its own research as well as other authors in a variety of fields and regions.

Innovativeness: is the degree to which an organization is relatively earlier in adopting new ideas than other organizations.

The S-Shaped Curve of Adoption and Normality: The adoption of an innovation as indicated in Figure 2 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.

Figure 2 – Roger's S-Shaped Curve of Adoption and Normality



Source: thehealthcareblog.com

Adopter categories: Is the classification of member of a social system (e.g. airports) on the basis of innovativeness.

Roger's five categories of innovators are represented in Figure 2 and defined below. They are based on the two main parameters of a normal distribution (i.e. Mean or average "*X*" and standard deviation "sd") (Rogers, 1995: 223)

- *Innovators*: 2.5% of adopters included between [(First adopter) - (*X*-2sd)]
- *Early adopters*: 13.5% of adopters included between [(*X*-2sd) - (*X*-1sd)]
- *Early Majority*: 34.0 % of adopters included between [(*X*-1sd) - *X*]
- *Late Majority*: 34.0 % of adopters included between [*X* - (*X*+1sd)]
- *Laggards*: 16.0% of adopters included between [(*X*+1sd) – (Last adopter)]

This classification of organizations is based on the time of adoption. Next section introduces the characteristics of organizations related to innovation.

3.6. Organizational Characteristics and Innovation

The relationship between organizational characteristics of organizations and innovation has been a widely studied among organizational innovation researchers (Damanpour, 1991). Frambach et al. (2002) defined three groups of characteristics: 1) Organization size; 2) Organization structure; and 3) organization innovativeness.

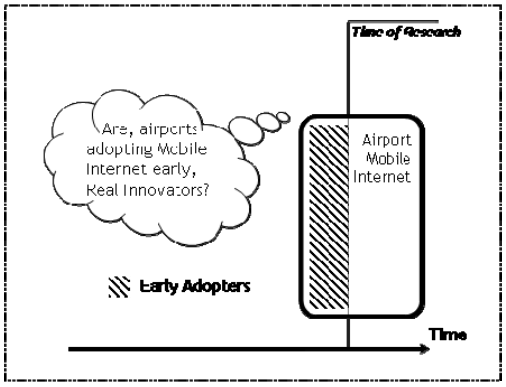
Frambach et al. (2002) points out that size has repeatedly been found to influence the propensity to adopt. Usually, size is found to be positively related to innovation adoption. However, it is also argued that smaller organizations are more flexible to innovate (Frambach et. al., 2002: 165). Lee et al. (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.

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 services in mobile internet businesses differed across countries. Thus, innovation patterns are expected to differ across different geographical locations.

4. Theoretical Model

This model aims to find out if airports early adopters of mobile Internet can be considered real innovators (see Figure 3). The model is built step by step introducing some of the concepts of innovation theory reviewed in Section 3 and defining the corresponding hypothesis. The term "real innovator" is also defined.

Figure 3 – Conceptual Model – 1 of 5



Source: author

4.1. Bell-Shaped Curve of Adoption

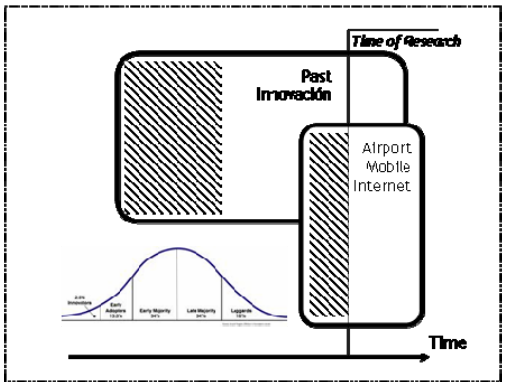
Rogers (1995) points out that innovation adoption follows a normal bell-shaped curve when plotted over time on a frequency basis. In order to confirm Roger generalization, the adoption needs to be adopted by all organizations.

The use of mobile Internet by airports, at the time this research is carried out, is not completed (i.e. only a number of airports have adopted mobile Internet). Thus, this innovation cannot be tested for normality.

Tornatzky et al. (1982) suggests that innovation studies should study the adoption of more than one innovation to have more solid data. Following those suggestions and in order be able to test normality on the adoption pattern, this model includes a second innovation. The second innovation will be similar to mobile Internet and needs to be adopted by all organizations (i.e. airports in the study). Thus, the innovation adoption will be possible to be tested for normality.

The model at this point (Figure 4) includes the airport mobile Internet adoption (not fully adopted by all airports yet) and a similar innovation adopted before (past innovation). Both similar innovations are assumed to follow a bell-shaped curve of adoption (Rogers, 1995: 181).

Figure 4 – Conceptual Model – 2 of 5



Source: author

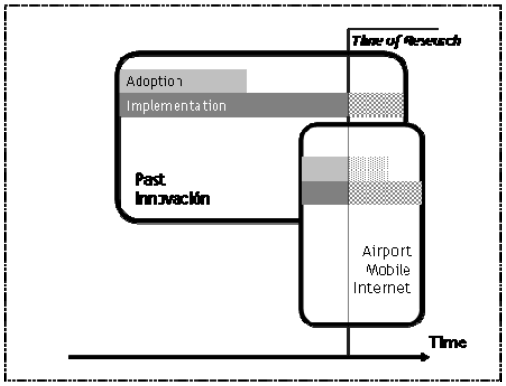
Hypothesis 1: The past innovation for which adoption was finalized follows a bell-shaped curve.

4.2. 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 December 2010 (Schiphol.com, 2010) and in April 2011 released a new English version where it was possibility to book parking from the application (Apple.com, 2011). Thus, to measure the innovation of airports by looking only the time when the mobile Internet is first implemented does not seem to be sufficient (Frambach et al., 2002: 164), (Tornatzky et al., 1982: 2). Thus, the degree of implementation of the innovation is also included in the model.

The degree of implementation will be analyzed for both innovations. As shown in Figure 5, such degree of implementation is measured in both cases at the time the research is carried out. The implementation time of the first innovation will be longer than the implementation time for the mobile Internet adoption. This fact should be taken into account when selecting the variables which indicate the degree of implementation of each innovation.

Figure 5 – Conceptual Model – 3 of 5



Source: author

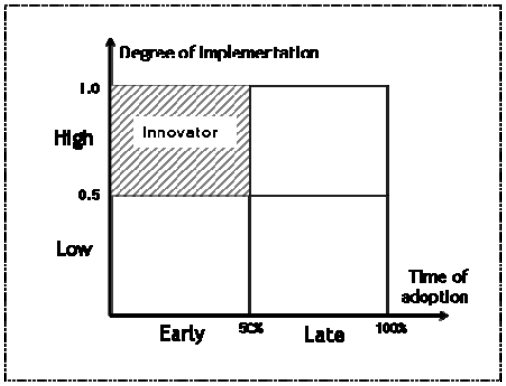
Rogers' (1995) adoption categories (innovator, early adopter, early majority later majority and laggards) where based only, on one dimension (time of adoption). The introduction of the new dimension (degree of implementation) would make it difficult to keep the five categories used by Rogers (1995), as the total number would be multiplied by the number of categories based on the second dimension. Thus, an aggregation of Roger's categories was carried out.

The first three Rogers' (1995) categories (innovator, early adopter, early majority) is converted into one, called early adopters. Rogers' (1995) last two categories (later majority and laggards) are converted into one, called late adopters. Then, with the aim to have similar number of total categories (four instead of five), the second dimension is also divided into two categories.

The time of adoption axis has two categories: Early adopters for the first 49.9% of airports adopting the innovation, and late adopters, for the second half of the airports (50-100%) adopting the innovation. 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 6).

Innovator is defined as the airport which adopts the innovation early and has a high degree of implementation, at the time the analysis takes place. Figure 6 shows the area where innovative airports will appear when plotting time of adoption and degree of implementation for each airport.

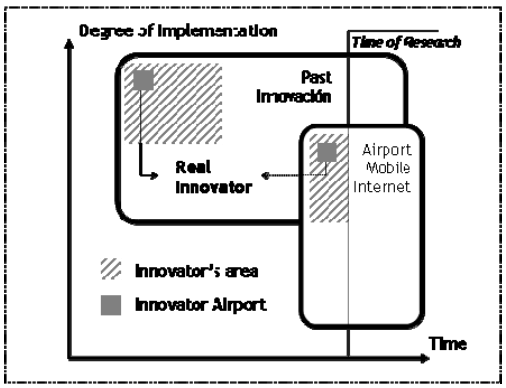
Figure 6 – Conceptual Model – 4 of 5



Source: author

We have defined a methodology to define which airports are considered to be innovators. The model requires this methodology to be applied into the two innovations under study as represented in Figure 7. Real Innovator is then defined as the airport which is founded to be innovator in the two innovations under study (i.e. past innovation and the mobile Internet adoption). Thus, the model fulfills its aim of finding out which airports who adopts early mobile Internet can be considered real innovators.

Figure 7 – Conceptual Model – 4 of 5



Source: author

4.3. Characteristics of Airport Innovators

From the group of innovator airports will be possible to analyze some of its characteristics or attributes, which can help us to understand its relationship with innovation.

One characteristic which have been found on previous research to explain innovation is organization size (Damanpour, 1991: 574), (Frambach et al., 2002: 163), (Lee, 2006: 975). In general, organizational size and innovation have founded to be positive related.

Besides the size of the organizations, another characteristic that can explain innovation is the physical location. Organizations with geographical proximity are more likely to have similar patterns of innovation adoption (Kumar et al., 1998). This is also applicable for the mobile Internet adoption (Kim et al., 2004). Thus, the geographical location of airports is expected to influence the level of innovation.

The relationship between airport characteristics and innovation led us to define the following two hypotheses.

Hypothesis 2: Larger airports are more innovators.

Hypothesis 3: Airports will be more innovators depending on the regions where are located.

5. Conclusions

The challenges faced by commercial airports to develop commercial revenues requires of certain innovation. The implementation of new services by airports using mobile Internet is a way to innovate. Thus, the use of mobile Internet adoption to measure innovation seems to be an appropriate approach.

Innovation is often measured as dichotomous adoption not adoption, taking the time of adoption as the only variable defining which organizations are innovators (Rogers, 1995). However, such approach does not seem to be appropriate for the study of adoption of mobile Internet by airports. Following Tornatzky et al. (1982) recommendation, the degree of implementation of mobile Internet at the time of the study is also included into the model.

The variables, time of adoption and the degree of implementation, are mean to be applied to mobile Internet adoption as well as another similar innovation. The result is expected to provide with solid results confirming which airports are real innovators.

Two implications of this study are highlighted: Firstly, the present study on the adoption of mobile Internet by airport represents a new line of academic research. The actual new services and potential new services provided by airports with mobile Internet could mean that this new topic is also included in future research on airport management and airport economics. Secondly, this paper contributes to acceptability research, whose main purpose is to identify the basis for positioning an innovation, so it will be more acceptable - i.e. to have more rapid rate of adoption (Rogers, 1995).

When applying this model, the following limitations should be considered. First, the model was designed for innovations which were adopted or are expected to be adopted by 100% of the airports. Second, the measurement of the degree of implementation variable requires of the definition of implementation variables. Those variables will have to be carefully chosen by the researcher as will partially indicate which organizations are real innovators.

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