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Development of a web-based mobile airline ticketing model with usability features

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Abstract

Purpose – Development of mobile commerce (m-commerce) environments that have user-friendly features is important to accelerate the adoption of m-commerce. The current research studies web-based features that are crucial to the success of mobile air ticketing commerce.

Design/methodology/approach – There are two phases involved. In the first phase, the current research develops a web-based mobile airline ticketing (W-MAT) model to study usability features necessary to perform mobile air ticketing commerce. Thirty-six features are mapped and identified based on the W-MAT model. In the second phase, the air ticketing web sites for 27 most popular airline companies and online air travel agencies are examined to analyze their existing implementation patterns on these 36 features. The pattern analysis is based on web site features analysis and web site versatility analysis.

Findings – The analysis of web site features resulted in the development of an adoption feature pyramid that classified the 36 features into three categories. The analysis of web site versatility was based on multivariate cluster analysis that classified these 27 web sites into four groups.

Practical implications – The findings on web site features and web site versatility analyses in the current research are beneficial to future m-commerce airline companies and air travel agencies, mobile device developers, and air ticketing m-commerce interface designers.

Originality/value – The study concludes that the W-MAT model-based air ticketing features with usability emphasis are crucial to develop efficient mobile air ticketing web sites; and thereby, accelerating the adoption of m-commerce for the air travel industry in the near future.

Keywords Electronic commerce, Internet, Airlines, Mobile communication systems, Customer satisfaction

Paper type Research paper

1. Introductions

The US airline industry lost 15 billion in 2002 and 2003 and is expected to lose another five billion in 2005 (Will, 2004). Most organizations in the airline industry have attempted to respond to the financial turmoil through drastic evolution. Since the tragedy in September 2001, the network or legacy carriers have sought ways to improve business values and minimize losses by cutting jobs, eliminating routes, decreasing infrastructure, streamlining production costs, improving customer services, and creating a profitable market (Will, 2004). One of the most effective solutions for increasing business values, attracting more customers, and increasing customer satisfaction is to provide internet-based low-fare air travel tickets (Marks, 2004), i.e. to

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sell low-fair air travel tickets and expedite boarding processes through company web sites. Currently, many airlines are utilizing their own web sites to market and sell their products to current and potential customers. Some airlines also offer discounts to customers who purchase their tickets online (Hanke and Teo, 2003). Through the expanded use of the internet-based ticketing, airlines are able to reduce labor costs and in some cases eliminate commissions altogether so as to improve profit margins.

To sustain a significant competitive advantage, innovation and product differentiation are critical for organizations. The next opportunity for airlines to reach new markets, maintain low distribution costs, and enhance customer values and satisfaction can be achieved through the use of mobile technologies, including using mobile devices to purchase online air tickets (Hanke and Teo, 2003). However, unlike electronic commerce (e-commerce) participants, users of mobile commerce (m-commerce) usually find themselves in an unfamiliar and unpredictable environment (Perry *et al.*, 2001); and therefore, developing a user-friendly interface can reduce the constraints put by the unpredictability of the mobile environment.

The adoption of mobile ticketing (m-ticketing) will enhance the flexibility and effectiveness of using electronic ticketing (e-ticketing) due to its inheriting mobility by using mobile devices. However, the adoption of m-ticketing in the air travel industry is still slow and has not been widely implemented. In the US, the United Airlines is the only airline company that currently provides m-ticketing. The development of m-commerce environment with user-friendly features is important to accelerate the adoption of m-commerce in the air travel industry. Motivated by the apparent lack of literatures in the area of m-ticketing, the current research aims at studying web-based features that are crucial to the success of mobile air ticketing commerce. Specifically, the objectives of the current study are to:

- analyze the existing air travel ticketing web site features and transaction flows and develop a web-based mobile air travel ticketing model to provide foundations to study air travel ticketing usability features necessary in m-commerce;
- develop user-friendly features of air travel ticketing that are important for mobile customers;
- analyze web site features and web site versatility for air travel ticketing; and
- classify air travel ticketing features in terms of their adoption patterns.

The current paper is organized as follows: Section 2 consists of the literature review. Section 3 develops a web-based mobile airline ticketing (W-MAT) commerce model. Section 4 presents the methodology by mapping m-commerce flows in the W-MAT model into mobile air ticketing features, and identifies 36 user-friendly features for mobile air travel ticketing. The existing airline ticketing web sites in e-commerce for 27 airline companies and online air travel agencies are examined. Section 5 presents findings, and Section 6 presents discussions and conclusions.

2. Literature reviews

2.1 M-commerce

Generally, e-commerce is defined as a monetary transaction conducted using the internet and a desktop or a laptop computer (Will, 2004). M-commerce can be defined as a

transaction that takes place via wireless internet-enabled technology (through handheld computers, cellular phones, personal digital assistants (PDAs), or palmtop computers) and that allows for freedom of movement for the end user. Wireless Fidelity (Wi-Fi), the transmission of short-ranged radio signals between a fixed-based station and an end-user's mobile device, is the driving technology that facilitates m-commerce (Wireless Computing, 2003). M-commerce is also defined as transactions using a wireless device and data connection to result in the transfer of monetary values in exchange for information, services, or goods. An m-commerce transaction is any type of transaction of an economic value, which is conducted via a mobile device that uses a wireless telecommunications network for communication with the e-commerce infrastructure (Tsalgatidou *et al.*, 2000; Rao and Minakakis, 2003). Turban *et al.* (2004) defined m-commerce as a monetary transaction for goods and services conducted by a mobile device, an operating system specific to mobile devices, and a mobile-dedicated network.

While m-commerce can be described as a natural extension of classical PC-based e-commerce into the wireless and mobile arenas, there have been modest disagreements in the definition of m-commerce and its difference from classic e-commerce (May, 2002). The major differences between m-commerce and e-commerce include modes of communications, communication protocols, operating systems specific to access devices, types of internet access devices, development languages, enabling technologies to support each environment, activities conducted, and personalization features (Turban *et al.*, 2004; Coursaris *et al.*, 2003; Teo and Pok, 2003).

Since electronic data transmission is the fundament in both e-commerce and m-commerce transactions, to some extent, m-commerce can be seen as a mobile branch of e-commerce. However, in this study, both e-commerce and m-commerce are handled as two independent concepts and as alternatives to each other for comparison purposes. In the current research, m-commerce refers to a monetary transaction for goods and services conducted via wireless internet-enabled technologies, such as wireless network, mobile devices, and operating systems specific to mobile devices.

2.2 M-commerce usability

Debates on pros and cons of m-commerce are complicated (Jarvenpaa *et al.*, 2003; Lee and Benbasat, 2003; Magura, 2003). Some doubts and concerns arose when high hopes and anticipations of m-commerce deflated in the last few years (Jarvenpaa *et al.*, 2003; Stafford and Gillenson, 2003). Usability is one of the biggest challenges issues in adopting m-commerce. Research indicates new challenges in usability design in m-commerce that are not present in e-commerce, including small screen size, limited screen resolution, limited processing capabilities, limited battery power of mobile devices, and cumbersome input mechanisms (Ghinea and Angelides, 2004). Sears and Arora (2002) mentioned that the most important user-related obstacle in m-commerce was the limited data entry and data retrieval capabilities. The data entry tools for mobile environment were significantly more limited than regular PCs and data entry performance was significantly lower with novice tasks. Venkatesh *et al.* (2003) indicated that the main challenges on using m-commerce included time pressure, location, convenience, device limitation, relevance, structure, personalization, and lack of standards and industry-specific design guidelines.

Nielsen *et al.* (2001) and Nielsen (1999) indicated several limitations on using cell phones to access mobile internet. These include:

- the form of the cell phones being not a suitable design for data-rich interaction but more dictated by the distance between the human ear and mouth;
- the keypad dominating too much of the surface area, and a numeric keypad being a poor device for entering alphanumeric characters;
- the screen size of a mobile device (such as a cell phone or a PDA) being limited to 2-2.5 inches diagonally, while most desktop and laptop computers have screen sizes that range between 12 and 21 inches diagonally; and
- screen resolution and colors presently being significantly inferior to PC-based screens.

Ozok and Wei (2004) also identified additional usability difficulties with cell phone use including one of the hands being occupied while data entry is conducted with the other hand (using a stylus pen or the keypad), and more difficulties involve retrieval of information such as graphics being too small for legibility and taking a long waiting time to be downloaded.

User interface features including web page and content designs are key determinants of sales in online stores (Cao *et al.*, 2005). Web sites need to make sure the user interface experience satisfies both their sensory and functional needs to satisfy internet commerce usability expectations (Bellman *et al.*, 1999). While web site usability in e-commerce has received a large amount of attention in the previous literature (Yang and Tang, 2005; Kuo *et al.*, 2004; Cao *et al.*, 2005), m-commerce-specific usability remains unexplored for the most part. Understanding what is important to users is essential in creating a more compelling m-commerce experience, thereby potentially boosting profits (Venkatesh *et al.*, 2003).

A successful web presence for an e-commerce company does not directly translate to m-commerce success. Venkatesh *et al.* (2003) indicated that a one-to-one content translation from e-commerce to m-commerce is not an optimal solution. There are several fundamental challenges for transferring web sites from e-commerce to m-commerce. The first is the human factors-related issue with the small keypads and limited display interfaces of mobile devices; therefore, m-commerce web site designers should offer shrunk web pages with a limited number of features on the mobile interface rather than offering the high number of features on regular sites. Second, the key in m-commerce success has so far been the ability to present content to users in a customized fashion. The goals m-commerce customers try to achieve are different than their goals in the e-commerce environment, because in m-commerce environment goals are often conducted based on a location or time pressure (Sadeh, 2002). M-commerce aims at providing services to support time-critical activities, and designers need to leverage the desires for specific usability aspects of m-commerce. Third, Chau *et al.* (2002) indicated that cultural differences would no doubt have to be explored for m-commerce development just as in the early days of e-commerce when it was a new notion. Fourth, Palen and Salzman (2002) identified security as part of the advancement of usability in m-commerce and a part of the overall system complexity. From a customer perspective, the issue of information privacy is of growing concern as our society becomes more and more digitized (Kelly and Erickson, 2004). Ozok and Wei (2004) also concluded that user trust in secure data transmission using wireless networks was significantly lower than those of networks used by PCs.

In summary, the literature indicates that m-commerce is still in the early stage. With few usability studies having been conducted and no guidelines being in place, usability and user preferences concerning m-commerce lack clarity. The current literature review also indicates that the m-commerce is indeed promising, as mobile devices become more popular and more acceptable among customers. The increasing acceptance of the mobile technology is conspicuous in the air travel industry, in particular. Air travelers are on the go, and mobile devices give them a tool to stay informed at all times (Marks, 2004). Therefore, the current study focuses on understanding the opinion of mobile air travel ticket shoppers from a usability perspective and developing a successful m-commerce environment for the air travel industry by uniquely combining and studying the concepts of m-commerce, usability and the air travel.

3. A web-based mobile airline ticketing model for m-commerce

Shih and Shim (2002) developed an m-commerce framework that focused on the inside of business scenarios to utilize m-commerce. The current research develops a web-based model for mobile air travel ticketing that sprung from Shih and Shim's (2002) framework and focuses on the usability features of the web sites through which transactions are conducted. A secure electronic payment system with many payment alternatives developed by O'Brien (2004) is also integrated into the web-based mobile air travel ticketing model to enhance the features for payment transactions by adding in a payment server. Figure 1 shows a model for purchasing airline tickets using mobile devices that would be facilitated through the use of m-commerce technology, namely the W-MAT model.

Figure 1 shows information transactions for an air ticket purchasing via a mobile device such as a cell phone, a handheld computer, a PDA, or a palmtop computer. The mobile customer uses a wireless operating system specific to the mobile device

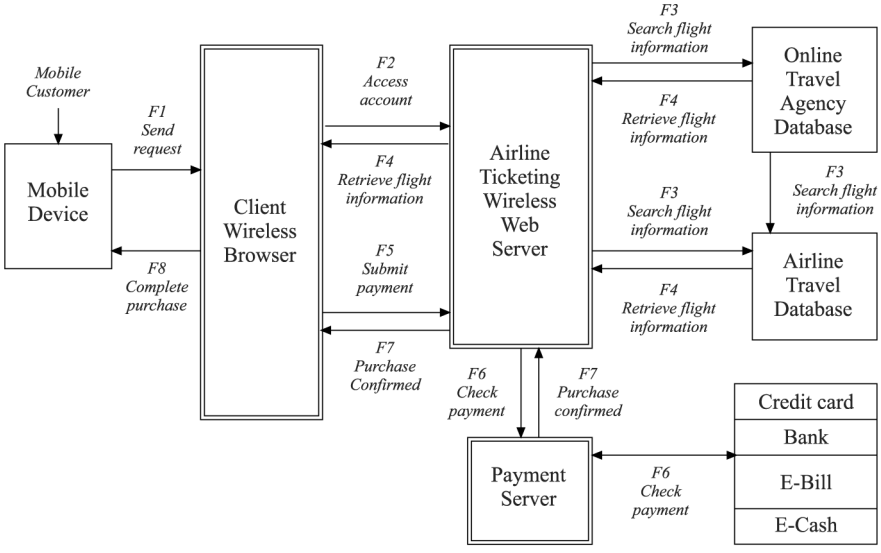

Figure 1.
A W-MAT m-commerce model

and wireless web browser. The communication between a client and a server is based on wireless network and wireless application protocols. On the airline ticketing server site, the wireless web server is used and wireless web development is based on wireless markup language. There are eight transaction flows (Flows F1-F8) involved in order to complete the m-commerce information transactions:

(1) *Flow F1 (send request).* A mobile customer enters data and specifies the requests. The request is sent via a mobile device to the client browser.

(2) *Flow F2 (access account).* The customer uses a wireless device to log onto m-commerce sites of major airlines or air ticket agencies that are available. The airlines and airline agencies recognize the customer.

(3) *Flow F3 (search flight information).* The travel agency transfers the mobile customer's request to multiple airlines databases.

(4) *Flow F4 (retrieve flight information).* Airlines that have matching flights to the customers' requirements send back the information to the customer via online travel agency's user interface. After evaluating the various flight options and their respective fares, the customer enters a personal identification number (PIN), and his/her credit card information (if not already on file), and selects his/her flight. The data is sent via encrypted signal to the respective airline to ensure that the seat remains available during the transaction process.

(5) *Flow F5 (submit payment).* When the customer accepts the proposed itinerary and the fare, payment information is sent to the credit card processing company. The encrypted signal is simultaneously transmitted to the credit card company to ensure that sufficient funds are available and no account discrepancies are present.

(6) *Flow F6 (check payment).* The credit card processing company credits the payment to the online travel agency's account.

(7) *Flow F7 (purchase confirmed).* Upon positive indication from the payment company (such as credit card company), the airline travel ticket server accepts the customer's travel request and issues a confirmation number. The confirmation number, m-ticket and a mobile receipt (m-receipt) are sent to the customer via client browser. An m-receipt is also sent to the payment server (e.g. credit card company). The customer can also get an mobile boarding (m-boarding) pass with bar codes through a wireless device.

(8) *Flow F8 (complete purchase).* When the purchase is completed, the mobile customer can check schedule and gate information for the booked flights. More links to other web sites such as weather information and destination maps.

In Figure 1, Flow F1 is the most crucial user interface medium through which mobile customers interact with the service providers and vendors. Flow F2 is an order-fulfillment process related to the specialized membership information for mobile customers and redeems coupons provided by m-commerce companies. Flows F3 and F4 are also critical since they demonstrate the strength of supply chain management in the m-ticketing process. Flows F5-F7 determine the supplier-customer management and the electronic fund transfer (EFT) capability of the web-based m-ticketing. Flow F8 deals with additional partnership information.

4. Methodology

4.1 Features of web-based airline ticketing m-commerce

The eight transaction flows developed in the W-MAT model in Figure 1 are categorized for the purpose of further grouping the features into various segments of the m-ticketing transaction. By breaking down the eight functional information transaction flows in the W-MAT model and mapping these flows into user-friendly features, a total of 36 features were identified (Table I). Most emphasis was put on the user-friendliness of the interface, namely, how easily and quickly a mobile customer can get the information needed and complete a purchase transaction. Some of these features were adopted and modified based on m-ticketing features of air travel agencies developed by Chun and Wei (2004).

4.2 Data collection

The literature indicates m-commerce as an extension of e-commerce that allows users to interact with other users and businesses anytime and anywhere; therefore, m-commerce and e-commerce have a lot in common. From the users' point of view, the most significant difference is the internet access interfaces. M-commerce itself is a relatively new area and, undoubtedly, mobile airline ticketing is not yet available worldwide. As many scholars and industry analysts have claimed, m-commerce is derived from e-commerce (Coursaris *et al.*, 2003; Ozok and Wei, 2004; Lee and Benbasat, 2003); therefore, e-ticketing that is more widely and popularly used should provide a good platform to analyze m-ticketing framework and provide guidelines on how mobile airline ticketing may be approached. The data collection in the current study on these 36 features is from existing web sites of the dominant US air travel companies and major online air travel agencies that offer e-ticketing.

The top ten US dominant airline industrial leaders and their market shares in 2004 are American (18.4 percent), United (16.5 percent), Delta (10.9 percent), Continental (10.5 percent), Northwest (10.4 percent), Southwest (7.5 percent), US Airways (5.7 percent), America West (3.3 percent), Alaska Airlines (2.5 percent), and JetBlue (2.3 percent), respectively (Corridore, 2004). In the current study, web sites for these top ten airline leaders are selected as the focus. In addition, an exhaustive search on the online air travel agencies is also conducted and their web sites are studied. These 17 agencies include 1,800 Cheap Seats, Airfare, Airtrek, All Cheap Fares, Cheap Air, Cheaptickets, Expedia, Hotwire, Lowest Fare, One Travel, Orbitz, Priceline, Travelhub, Travelosity, Travelselect, Travelworm, and Tripfox. Hence, a total of 27 major airline companies and online air travel agencies were selected as the study group and their web sites were examined based on these 36 features mapped from the W-MAT model. The results are summarized in Table II. In Table II, the web sites are listed in no particular order of significance; however, the features are listed in the order of how an m-ticket may be processed.

4.3 Validation of the W-MAT model-based usability features

As pointed out earlier, several noteworthy research studies were used for the development of the W-MAT model-based m-ticketing features in the current study. Of particular importance to the development of m-ticketing features include research by Chun and Wei (2004), Ghinea and Angelides (2004), Jansen and Karygiannis (1999), Nielsen *et al.* (2001), Nielsen (1999), O'Brien (2004), Ozok and Wei (2004), Palen and Salzman (2002), Sadeh (2002), Sears and Arora (2002), Shih and Shim (2002) and

Flows	Feature	Feature descriptions
F1: send request	F1a	Search begins at the homepage
	F1b	Dropdown menu available for the city code
	F1c	Dropdown calendar available
	F1d	Specific travel times can be chosen
	F1e	Both one way and round trip arrangements available
	F1f	Number of passengers traveling
	F1g	Vacation packages available
	F1h	Rental cars and hotel reservations links
	F1i	Point of contact phone numbers accessible within 1 click of homepage
	F1j	Domestic and international travel option
	F1k	Ability to select class of service (business, coach, etc.)
	F1l	Native language option available
	F1m	Collaboration with other web sites (collaboration among vendors)
F2: access account	F2a	Membership is required to book tickets
	F2b	Memory function available to view "my account" information
	F2c	Redeemable coupons are available
F3: search flight information	F3a	Bidding is available
	F3b	Multiple airlines can be searched
	F3c	Other options on similar schedules are available
	F3d	Frequent flyer miles from the selected airline can be used
	F3e	Frequent flyer miles from other airlines can be used
F4: retrieve flight information	F4a	Both e-ticket and paper ticket offered
	F4b	Flights are sorted by price
	F4c	Flights are sorted by other than price such as arrival time, flight duration, and airline
F5: submit payment	F5a	Currency converter is available
	F5b	Processing fee other than paper delivery charge is applied
	F5c	Source of payment security is available
F6: check payment	F6a	Payment option using credit card is available
	F6b	Payment option other than credit card (such as bank, e-bill, or e-cash) is available
F7: purchase confirmed	F7a	Issue an confirmation number after confirming payment information
	F7b	Travel itinerary e-mailed or faxed to the customer
	F7c	Receipt e-mailed or faxed to the customer
F8: complete purchase	F8a	Online check in offered
	F8b	Airport maps/diagrams are downloadable
	F8c	Links available to destination weather forecast sites
	F8d	Search flight status and gate information

Source: Some features are adopted and modified based on Chun and Wei (2004)

Table I.
Mobile airline ticketing features

Venkatesh *et al.* (2003). These earlier research efforts were used because they provided the needed technical perspectives as well as user-friendly features necessary in the air travel ticketing process-oriented structures that are critical for validating the proposed transaction construct.

Table II. Web site airline ticket features for airline companies and online air travel agencies

Feature	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17
F1a		Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y			Y
F1b					Y	Y	Y	Y			Y		Y			Y				Y					Y	Y	
F1c		Y		Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
F1d	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
F1e	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
F1f	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y
F1g		Y		Y	Y		Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
F1h	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
F1i					Y	Y					Y	Y	Y	Y	Y		Y				Y				Y	Y	
F1j		Y		Y	Y	Y	Y		Y	Y	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y
F1k		Y	Y	Y	Y					Y				Y				Y					Y		Y		
F1l																											
F1m	Y																		Y	Y		Y					
F2a											Y		Y		Y		Y	Y		Y	Y	Y		Y	Y		
F2b	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y
F2c		Y		Y	Y	Y	Y	Y	Y								Y										
F3a																			Y	Y		Y					
F3b											Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
F3c		Y		Y				Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
F3d	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y																
F3e	Y	Y	Y	Y	Y		Y		Y	Y	Y			Y	Y	Y	Y		Y			Y	Y	Y	Y		Y
F4a	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y					Y					Y			Y			
F4b		Y	Y	Y		Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
F4c													Y			Y	Y		Y	Y	Y	Y					Y
F5a						Y																					
F5b	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y
F5c	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
F6a	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
F6b															Y												
F7a	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
F7b	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
F7c	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
F8a		Y		Y	Y					Y																	
F8b																											
F8c					Y																						
F8d		Y		Y	Y	Y			Y																		

Notes: C1-C10 are airline companies, including Alaska, American, America West, Continental, Delta, Jet Blue, Northwest, Southwest, United, and US Airways Airlines, respectively. A1-A17 are online air travel agencies, including 1,800 Cheap Seats, Airfare, Airtrek, All Cheap Fares, Cheap Air, Cheaptickets, Expedia, Hotwire, Lowest Fare, One Travel, Orbitz, Priceline, Travelhub, Travelosity, Travelselect, Travelworm, and Tripfox, respectively

From a practical perspective, the W-MAT model-based m-ticketing features can be validated by comparing m-ticketing features developed in the current research with the existing implementation patterns of these features in the e-ticketing. The 36 m-ticketing features in Table II covered more than existing user-friendly features from the 27 air travel company web sites by incorporating special mobile environment requirements including mobile devices. For example, Features F8b and F1l have been covered in the W-MAT model-based m-ticketing features developed in the current research, but not covered by the existing companies' e-ticketing features.

5. Findings

Table II presents some unanimous basic attributes among web sites of airline companies and agencies. However, there are several features that are used to help differentiate each web site as well. Further analyses are conducted and the findings based on the features gathered from top ten airline companies' and 17 online air travel agencies' web sites are tallied. Specifically, first, the numbers of web sites that provide each feature are tallied to find the most widely used features. Second, the numbers of features that various web sites provide are tallied to analyze the versatility of those web sites.

5.1 Web site features

The distribution of 36 features among 27 web sites from Table II is tallied to separate the most widely used features from those that are not. Table III presents this distribution.

In Table III, the most widely used features are Features F1a, F1c, F1d, F1e, F1f, F1g, F1h, F1j, F2b, F3c, F4b, F5b, F5c, F6a, F7a, F7b, and F7c (75 percent or above) (17 features), which are usually found in the first sending request page (Flow F1) and confirm purchase (Flow F7). This observation clearly validates the importance of user-friendliness of the web site's interface.

The least commonly used features are Features F1l, F1m, F3a, F5a, F6b, F8a, F8b, F8c, and F8d (20 percent or below) (nine features). These features do not seem to be directly related to the immediate need of travel, explaining why those features are not very popular among web sites studied. For example, Features F6b and F8c have been implemented by only one company. None of the companies implemented Feature F5a and F8b. Even though these feature are important and have potential benefits, they still have not been widely adopted.

The rest of the features are Features F1b, F1i, F1k, F2a, F2c, F3b, F3d, F3e, F4a, and F4c (ten features), which were implemented by some companies (between 20 and 75 percent). For example, Feature F2c "Redeemable coupon", which accounts for 29.6 percent, is not as ubiquitous as other features, but it may attract mobile customers, as both e-commerce and m-commerce get more popular.

Based on the examinations of existing electronic airline ticketing features for these 27 dominant airline companies and online air travel agencies, an airline ticketing feature adoption pyramid is constructed in Figure 2. The features that more than 75 percent of the web sites provided are classified as most widely used features (most adopted features), those between 20 and 75 percent widely used features (enhanced features), and those less than 20 percent least commonly used features (least adopted features).

Feature	Airline companies		Online air travel agencies		Airline companies and travel agencies	
	Total number of features	Percentage	Total number of features	Percentage	Total number of features	Percentage
F1l	0	0.0	0	0.0	0	0.0
F8b	0	0.0	0	0.0	0	0.0
F5a	1	10.0	0	0.0	1	3.7
F6b	0	0.0	1	5.9	1	3.7
F8c	1	10.0	0	0.0	1	3.7
F3a	0	0.0	3	17.6	3	11.1
F1m	1	10.0	3	17.6	4	14.8
F8a	4	40.0	0	0.0	4	14.8
F8d	5	50.0	0	0.0	5	18.5
F2c	7	70.0	1	5.9	8	29.6
F4c	0	0.0	8	47.1	8	29.6
F1k	5	50.0	4	23.5	9	33.3
F1b	4	40.0	6	35.3	10	37.0
F2a	0	0.0	10	58.8	10	37.0
F1i	2	20.0	9	52.9	11	40.7
F3d	10	100.0	1	5.9	11	40.7
F4a	9	90.0	4	23.5	13	48.1
F3b	0	0.0	17	100.0	17	63.0
F3e	8	80.0	11	64.7	19	70.4
F1j	7	70.0	14	82.4	21	77.8
F3c	5	50.0	16	94.1	21	77.8
F1a	8	80.0	14	82.4	22	81.5
F1g	7	70.0	16	94.1	23	85.2
F1c	8	80.0	16	94.1	24	88.9
F4b	7	70.0	17	100.0	24	88.9
F1d	9	90.0	16	94.1	25	92.6
F1f	10	100.0	15	88.2	25	92.6
F5b	10	100.0	15	88.2	25	92.6
F1e	10	100.0	16	94.1	26	96.3
F1h	10	100.0	16	94.1	26	96.3
F2b	10	100.0	16	94.1	26	96.3
F5c	10	100.0	17	100.0	27	100.0
F6a	10	100.0	17	100.0	27	100.0
F7a	10	100.0	17	100.0	27	100.0
F7b	10	100.0	17	100.0	27	100.0
F7c	10	100.0	17	100.0	27	100.0

Table III.
Analysis of air ticketing web-based features

Some other major findings from Table III are:

- Three air travel agencies' web sites allow customers to bid prices for the airline tickets. These three web sites, "Lowest Fare", "One Travel", and "Priceline", established collaborations among them and direct customers to the partners when the customers acquire services that are not of their core competency. For example, "Lowest Fare" and "One Travel" simply direct their customers to "Priceline" when the customers want to bid the price; and therefore, "Priceline" is the only web site that allows customers to bid their own prices. On the other

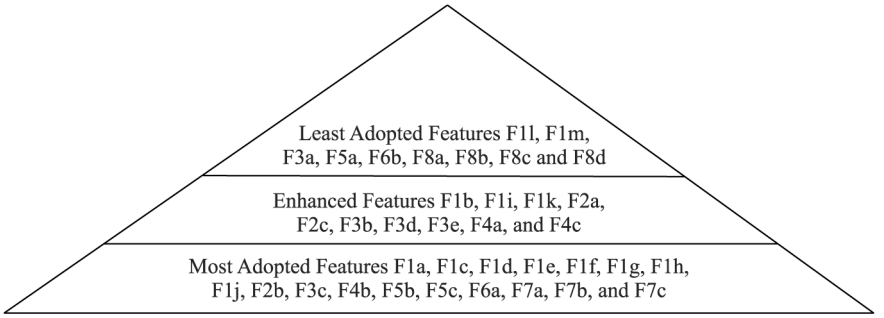

Figure 2.
Airline ticketing feature adoption pyramid

hand, "Priceline" also directs its customers to "Lowest Fare" when customers want to accept the advertised fare.

- Careful attention must be paid, however, in translating the tallied numbers. Some features are more hindrance than assistance to the users. At the same token, some of the features that are not as widely used as others can be of great assistance to the mobile customers. For example, for "dropdown calendar available" (Feature F1c), all 17 web sites have a dropdown calendar to choose desired travel dates (88.9 percent), except for "Alaska", "America West", and "Airfare". However, only ten web sites offer dropdown city codes to choose the origination and destination of the travel (Feature F1b), which accounts for 37.0 percent. When the city code is entered misspelled, none of the web sites without city codes allow dropdown menu searches for other cities with similar names. Instead, an error message or a new pop up window for more advanced search displays. The enhanced fail-safe feature by adding a dropdown menu for city code will not only save mobile customers' time, but also reduce the frustration for mobile customers when they are using the mobile devices in unfamiliar and unpredictable environments (Perry *et al.*, 2001).
- For 17 online air travel agencies, only four companies give an option to choose paper ticket over e-ticket. In US domestic flights, e-ticket is more prevalent. Even the companies that offer paper tickets impose a separate delivery charge for paper tickets on top of their regular processing fees. This supports the paperless business or electronic business trend in other industries as well, including billing, banking and mortgage. The only exception is for the international flights where paper tickets are more prevalent than e-tickets.
- Credit card payment is the primary method of all online air ticketing. This payment method enhances the mobility and speed of the airline m-commerce. Moreover, all these 27 air ticketing web sites provide the security source they utilized for their online payment processing.
- In airline ticketing using mobile devices, the least commonly used features become more important than those used in e-commerce. For example, Feature F8d "check flight status and gate information" provides the most convenience for mobile consumers and travelers by allowing them to obtain updated information on the flight status, flight schedule changes, and gate information anytime and anywhere. This feature shows a clear advantage of using mobile devices for this function compared to using wired desktop PC and notebook (e-commerce).

5.2 Web site versatility

The web site versatility of these 27 airline companies' and online air travel agencies' web sites are studied in the current research. The total number of features and percentages for each of the 27 web sites are presented in an ascending order in Table IV. In Table IV, out of these 36 features available, all of the 27 web sites studied have at least 15 or more of the features that are implemented. Other major findings including:

- All of the 27 web sites have implemented above 50 percent for these 36 features, except for only four web sites, "Alaska (C1)", "Airtrek (A3)", "America West (C3)", and "Airfare (A2)", which implemented from 41.7 to 47.2 percent (lower than 50 percent) for these 36 features. Moreover, one web site that has implemented features more than all the others (69.4 percent) is C5, "Delta Airlines".
- There are 15 web sites that offer more than the average number of features (20.7) and 12 web sites that offer less than the average number of features (20.7).
- The percentages out of the 36 features implemented in the 27 web sites are between 41.7 and 69.4 percent. "Delta Airlines (C5)" has the highest number of features (25 features), and "American Airlines (C2)", "Continental Airlines (C4)", and "1,800 Cheap Seats (A1)" have the second highest number of features (24 features), while "Alaska (C1)" has the lowest number of features (15 features).

Feature	Total number of features for each company	Percentage of features for each company
C1	15	41.7
A3	16	44.4
C3	17	47.2
A2	17	47.2
A13	18	50.0
A16	18	50.0
C8	19	52.8
C6	20	55.6
C7	20	55.6
A4	20	55.6
A8	20	55.6
A17	20	55.6
A9	21	58.3
A14	21	58.3
A15	21	58.3
C9	22	61.1
C10	22	61.1
A5	22	61.1
A6	22	61.1
A7	22	61.1
A11	22	61.1
A10	23	63.9
A12	23	63.9
C2	24	66.7
C4	24	66.7
A1	24	66.7
C5	25	69.4
Average	20.7	57.41

Note: C1-C10 and A1-A17 have the same notation meaning as those in Table II

Table IV.
Analysis of air ticketing web site versatility

Cluster analysis is conducted to further analyze the classifications of these 27 air ticketing web sites. Several cluster analysis methods exist, including *Hierarchical* cluster method, *Fastclus* cluster method, and *Modelclus* cluster method. Fastclus cluster method is used to find disjointed clusters of observations using a k-means method. This method is suitable for data sets in the current study (SAS, 2003).

Thirty-six variables relate to these 36 web interface features, and 27 observations to 27 web sites. A total of 30 iterations have been conducted.

The graphical representation of cluster analysis results from SAS is shown in Figure 3, where OB1-OB10 are corresponding to airline companies C1-C10, and OB11-OB27 are to online air travel agencies A1-A17 in Table II.

If using average distance between clusters of 1.0, there are four clusters can be identified from Figure 3. Table V summarizes these four clusters.

In Table V, Cluster 1 has eight airline companies, and Cluster 3 has 15 online air travel agencies. Clusters 2 and 4 are mixture of airline companies and online air travel agencies.

6. Discussions and conclusions

The current research developed a web-based mobile air travel ticketing commerce model by considering the usability features and studied the existing m-commerce environment. The breakdown of the m-ticketing information transaction flows from the W-MAT model can allow airline companies and air travel agencies to determine what features need to be concentrated on differentiate themselves from their competitors. The findings from the current research indicate that developing user-friendly m-commerce features is crucial to the success of m-commerce. There are three major findings in the current study.

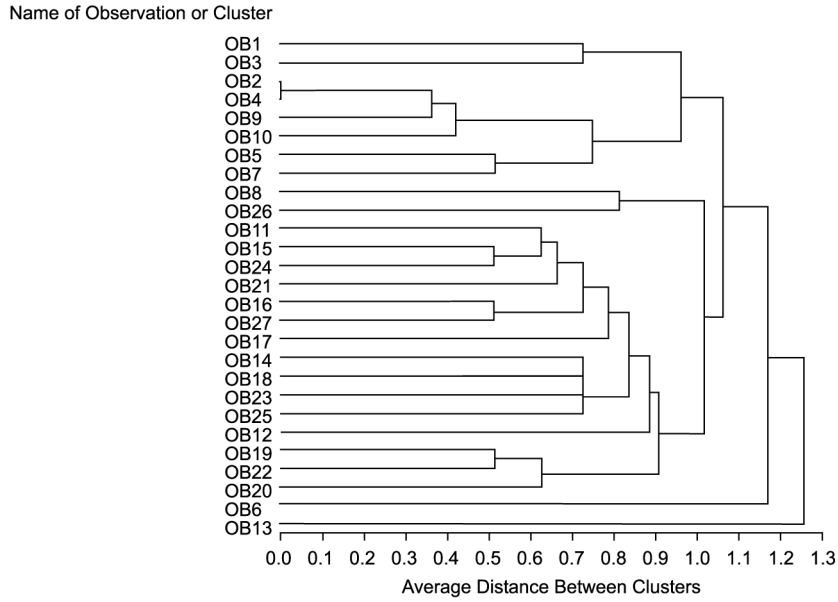

Figure 3.
Graphical representation of cluster analysis results from SAS for 27 web sites

Cluster number	Number of airline companies' or online air travel agencies' web sites	Airline companies or online air travel agencies[a]	Clusters for observations from SAS[b]
1	8	C1-C5, C7, & C9-C10	OB1-OB5, OB7, & OB9-OB10
2	2	C8 & A16	OB8 & OB26
3	15	A11-A12, A14-A25, & A27	OB11-OB12, OB14-OB25, & OB27
4	2	C6 & A3	OB6 & OB13

Notes: [a]C1-C10 correspond to ten airlines, and A1-A17 seventeen online air travel agencies in Table II; [b]OB1-OB10 correspond to C1-C10 and OB11-OB27 are to A1-A17 in Table II

Table V.
Cluster analysis on web-based airline ticketing features

First, it is not the number of features but the usefulness of the features that is critical to the success of m-commerce. Seventeen features are most widely used features that were available at 75 percent or over of the web sites, while nine air ticketing web features were available at 20 percent or less than of the web sites. All of the 27 web sites studied in the current research have at least 15 features. However, some air travel ticketing web sites streamlined the features better than others so that the users can get the information they want faster than they could have done on other web sites.

Second, the air ticketing feature adoption pyramid developed in the current research reflects the availability of air travel ticketing features. An airline company or online air travel agency might consider adding more features (such as least adopted features) to distinguish its web site from those of the competitors, and enhance the user-friendliness for mobile air travel ticketing interfaces' design, thereby possibly gaining in popularity. For example, the "redeemable coupons (Feature F2c)", which is available at only eight web sites, may become more prevalent once e-ticketing and m-ticketing become more popular. The "dropdown menu for the city code (Feature F1b)" would allow users to increase the search process speed and save time. However, this feature (F1b) has been implemented by only ten web sites.

Third, in the airline ticketing feature adoption pyramid, out of these 17 most adopted features, approximately half are there to increase the search process speed and fail-safe users' data entry. This is particularly important to determine the success of m-commerce. Unlike e-commerce devices, m-commerce devices have many limitations such as limited size, display window, processing power, and bandwidth (Tarasewich, 2003; Lee and Benbasat, 2003). Moreover, understanding socio-psychological aspects of m-commerce customers is essential to the success of m-commerce (Palen and Salzman, 2002; Lee and Benbasat, 2003). To coincide with the speed and the ubiquity of m-commerce, the customers of m-commerce are almost always on the go; and therefore, they usually have less time and patience than those of e-commerce. They also have less attention span and many other activities compete for their attention resources. Therefore, the ideal m-commerce user interface design must be able to not only attract new customers but also beat the distractions that are competing for the user's attention (Chun and Wei, 2004).

However, the most important consideration on m-ticketing features is still the user-friendliness of the interface. Given the limitations such as the limited size and display screen of mobile devices, careful consideration must first be given to choose features that work effectively in the mobile environment, and link these features

together effectively. One limitation of the current research is that the airline ticketing feature adoption pyramid developed is based on the quantitative analysis of existing air travel e-ticketing. The most (least) adopted features simply mean the most (least) frequently available features. Although these developed features are available at online air ticketing web sites, the high availability of certain features does not necessarily translate to the effectiveness or usefulness of the web designs. Our study also indicated that there were quite a few highly useful features not adopted widely by the company web sites. Therefore, further studies are needed on the usefulness of newly developed and not widely adopted features specific to mobile devices in e-ticketing, and for further validation of these features in air travel m-ticketing environment, either field or simulated experiments may be the next step.

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