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# Mobile Business as Strategic Tool in the US Airline Industry

by

# **Marzel Stratmann**

A Thesis Submitted to the Department of Business

Administration in Partial Fulfillment of the Requirements for the

Degree of Master of Business Administration (MBA) in Aviation

Embry-Riddle Aeronautical University

Daytona Beach, Florida, USA

Spring 2002

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# Mobile Business as a Strategic Tool in the US Airline Industry

# by

# **Marzel Stratmann**

This thesis was prepared under the supervision and guidance of the candidate's thesis committee chair, Dr. Notis Pagiavlas, Department of Business Administration, and has been approved by the members of the thesis committee. The thesis was submitted to the Department of Business Administration and was accepted in partial fulfillment of the requirements for the Degree of Master of Business Administration in Aviation.

## **Thesis Committee**

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Dr. Blaise Waguespack, Graduate Program Advisor

Dr. Daniel Petree, Department Chair, Business Administration

# Mobile Business Applications as Strategic Tools in the US Airline Industry by

# **Marzel Stratmann**

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#### Abstract

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Title: Mobile Business applications as Strategic Tools in the US Airline

Industry

Institution: Embry-Riddle Aeronautical University

Degree: Master of Business Administration in Aviation

Year: 2002

This thesis analyzes opportunities and threats of mobile business in the context of the US airline industry as s strategic tool to create a sustainable competitive advantage through the implementation of an effective mobile business model. The analysis is based on the assumption that mobile airline strategies have to create a strategic fit with the business environment seen from an airline perspective. Forces inherent in the global environment as well as in the micro-environment are analyzed using environmental scanning as systematic technique. Exploratory data obtained from a focus group interview is added to the analysis in order to assess opportunities and threats and to extract the key success factors for airline m-business, which is found to have tremendous impact on the way an airline creates value to its customers. Key success factors discussed in this thesis are user experience, the value contribution of mobile technology, and customer requirements. Crucial elements found for matching these factors are to expedite and facilitate processes, the ability to integrate systems into a mobile infrastructure, and using devices that yield quick and inexpensive results.

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# A Introduction

Most consumer studies relating to major US Airlines have shown little difference in perception of service quality<sup>1</sup>. This implies that switching costs for passengers between competing airlines are relatively low, making the industry vulnerable to price wars, especially in low demand periods. In terms of its structure, the airline industry is characterized by a trend towards consolidation. Yet, from an operating point of view, such strategies have not generated any significant cost savings.<sup>2</sup> Facing a demand that is greatly influenced by general economic factors, it remains an important task for airlines to increase operating efficiency and to reduce process costs in order to retain profit margins. Also on the service side, the US airline industry faces numerous shortcomings, the most important of which is record levels of passenger complains due to poor service and overcrowded infrastructure, especially at large hub airports.

In order to create an edge over competitors, companies need to create a sustainable competitive advantage, based on increased operational effectiveness as well as an adequate positioning strategy.<sup>3</sup> If integrated properly into the value chain, a mobile business model can increase an airline's operating efficiency and customer satisfaction. This can be achieved by facilitating business processes, providing customers with value added services and by creating synergies

<sup>&</sup>lt;sup>1</sup> Rhodes and Waguespack (2001) see quality levels converge based on the AQR.

<sup>&</sup>lt;sup>2</sup> Author unknown. (2001). Grounded Again. The Economist. Vo. 360, No. 8229, July 7th., pp 61-62.

<sup>&</sup>lt;sup>3</sup> Michael E. Porter. What is Strategy. Harvard Business Review (1996). November-December 1996. 61-78.

between an airline's core competencies and mobile technology.<sup>4</sup> Furthermore, implementing a mobile business model can increase the level of personalization of a company's business relations, which in turn creates new possibilities of customer segmentation. It might even allow companies to pursue a one-to-one marketing approach.<sup>5</sup>

Nearly all major US airlines have implemented mobile initiatives emphasizing the potential of m-business to differentiate their product and to reduce process costs. Most frequent applications aim at providing travelers with information, while some airlines have reconfigured existing processes allowing the purchase of tickets, check-in, and boarding via a wireless device. As next generation communication networks emerge and the wired Internet evolves into an ubiquitous infrastructure, the future success of an airline is likely to be substantially influenced by the effectiveness with which a mobile business strategy is implemented into the existing business model. This thesis analyzes the potential opportunities and threats for mobile business in the context of the US airline industry as an imperative to create a "strategic fit" between mobile strategy and the business environment.

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<sup>&</sup>lt;sup>4</sup> Joerg Zoebl. (2001). Mobile Business and M-Commerce. Muenchen Wien: Hansa. pp 290-293.

<sup>&</sup>lt;sup>5</sup> Patrick Brwise .(2001). TV, PC, or Mobile? Future Media for Consumer e-Commerce. Business Strategy Review, 2001, vol. 12 iss. 1. 35-42.

# **B** Methodology

Mobile Business as a strategic tool to build upon for creating a competitive advantage is analyzed in two parts. The first part is a secondary literature review developed through scanning the business environment of US based airlines. The second part is an empirical section generated by a focus group interview.

Environmental scanning is referred to as "sense-making" of the environment, attempting to generate a view of the firm's situation systematically through external and internal sources. As a precise situational view is the base for decision making in an organization, the scanning process is considered the core of strategic planning. Scanning as an analytical technique aims to detect future driving forces of the external environment assessing potential opportunities and threats inherent in the business environment. Generally, the analysis is divided into the global (macro) environment and the competitive (micro) environment. The segments of the global environment are social, political, macroeconomic, technological, and natural environment. The competitive environment is often characterized by Porter's five-forces analysis considering rivalry within the industry, customers, suppliers, substitute products, and new entrants. In this thesis, however, the micro-environment is reflected by mobile business and inherent opportunities and threats. Therefore, the

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<sup>&</sup>lt;sup>6</sup> K.B. Weick, "Sensemaking in Organizations", Thousand Oaks, 1995.

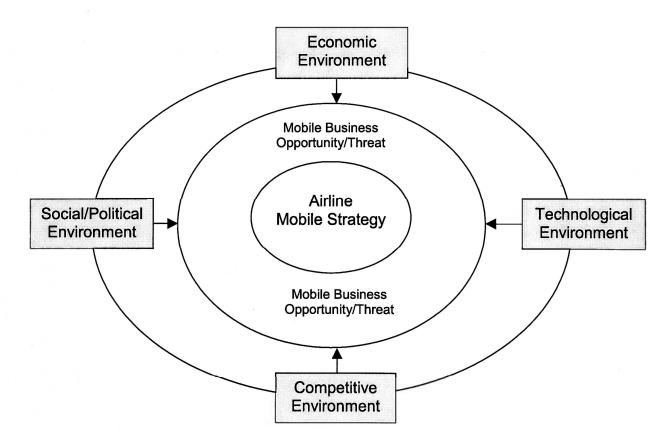
<sup>&</sup>lt;sup>7</sup> Thomson and Strickland, "Crafting and Executing Strategy", Mc Graw-Hill, 99-100.

<sup>&</sup>lt;sup>8</sup> Steinmann, Schreyoegg, "Management", Gabler, 5<sup>th</sup> edition, 163-163.

<sup>&</sup>lt;sup>9</sup> M. E. Porter, "Competitive Advantage", 1985.

competitive environment resembles a driving force in the global environment, as it is external to m-business, although it is seen from an airline's perspective. The idea is that forces inherent in the business environment of an airline create the context for mobile business opportunities and threats, with which an airline has to build a strategic fit. Hence, m-business becomes a strategic tool to position the firm and to create a sustainable competitive advantage.

Figure 1: Conceptual Framework



For the empirical analysis, originally a survey was planned to be conducted among travelers in two US airports. However, following the events of September 11, this was no longer feasible due to difficulties to enter airports with

the purpose to survey passengers, as well as due to the great uncertainty in the industry and among the traveling public at that time. As an alternative, an exploratory focus group interview was conducted among graduate business students at Embry-Riddle University. This target audience was regarded reasonable with the potential to simulate managerial as well as traveler thinking.

# **C** Environmental Scanning

# C.1 M-BUSINESS ENVIRONMENT

# C.1.1 What is M-Business?

Various related terms exist to describe business tasks performed by wireless transmission. Frequently used terms are m-commerce, mobile or wireless e-commerce, mobile computing, and mobile business. From a technological perspective, there is little difference in the meaning of each term. They are broadly used as synonyms and distinguishing between one from another is often more a matter of choice than of strategic consideration.

Nevertheless, from a business perspective there can be differences with respect to the strategic focus implied. Two general philosophies can be distinguished. One is to view m-business as an independent category that has the potential to substitute parts of e-commerce based on new technology. A second approach is to understand m-business as being a part of all e-commerce activities. Despite the focus emphasized, the general concept behind mobility can be defined as the buying and selling of goods and services through wireless devices, such as mobile phones, personal digital assistants (PDA), or pagers.

M-Commerce and mobile e-commerce can be interpreted as an extension of electronic commerce, which relates to all business transactions performed over the fixed-line Internet. A company emphasizing m-commerce focuses on

mobilizing the wire-based Internet, making it available to consumers. <sup>10</sup> Yet, this view lacks the understanding that some mobile applications may be very different from the ones that have been utilized as e-commerce activities over the Internet. While M-commerce suggests functions that are rather limited to the purchase of goods, mobile business provides a broader definition. It also encompasses internal business processes and transactions partially operated in the off-line world. <sup>11</sup> Delta Airlines' "virtual check-in", for example includes the possibility of checking-in by calling a toll free number. A barcode serving as boarding pass is then sent to the customer's mobile device. <sup>12</sup> By strict definition, this would not be a mobile e-commerce activity since the actual check-in call is executed in the off-line world. Nevertheless, the release of a boarding pass is a business process and is consequently included in the category of mobile business. To provide a broader view of the subject, the more comprehensive definition of m-business is employed in the environmental scanning analysis.

# **C.1.2 Applications of M-Business**

The most common applications of mobile business focus on exchanges between a business and consumers (B2C), between a business and its employees (B2E), as well as between two or multiple businesses (B2B). Other applications such as consumer to consumer, consumer to government or

<sup>&</sup>lt;sup>10</sup> P.J. Louis, "M-Commerce Crash Course: The Technology and Business of Next Generation Internet Services", McGraw-Hill, 2000, 207-209.

<sup>&</sup>lt;sup>11</sup> J. Zoebel (2001), Mobile Business und M-Commerce, 3-5.

<sup>&</sup>lt;sup>12</sup> In this case, the mobile device is a loyalty smart card.

between a business and professionals also exist to a lesser extend. Of increasing importance is also the exchange between machines. Frequent applications of mobile business are found in the banking industry, as well as in the travel and transportation industries. While many approaches towards mobile business attempt to translate Internet based applications into a wireless world, the most significant value contribution of mobile business could arise from new possible applications. One of these could be to execute small transactions such as the purchase of movie tickets or paying for parking. This approach would suggest that m-business should create new business models rather than competing with e-commerce. <sup>13</sup>

# C.1.3 Customer Requirements

In order for m-business to be successful, two basic conditions have to be fulfilled: M-business has to meet customer needs, and mobile technology must contribute value to fulfill these needs. The basic requirements from a customer point of view are that mobile business activities provide value added, they have to be easy and convenient to use, and they need to be executed within a short period of time. <sup>14</sup> Customers are likely to perceive value added if m-business enables them to be in control of activities, if processes are facilitated and expedited, and if the performance of activities is secure.

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<sup>&</sup>lt;sup>13</sup> "Why mobile is different", The Economist, October 13, 2001, 9-11.

<sup>&</sup>lt;sup>14</sup> Zobel (2001) argues that the user must be rewarded with a result within 3 minutes.

# **C.1.4 Technology Value Contribution**

From a general point of view, the list of features creating technologybased value for consumers includes ubiquity, specific context, interaction, the pay function, remote control, the receipt of proactive data, and entertainment. The most important aspects are ubiquity and context. Ubiquity refers to the possibility to perform tasks regardless of location. An example for the airline industry would be a mobile check-in process, which can be executed away from airports, for instance in a taxi or even from home. Context relates to the function of receiving specific information or applications based on the location and environment by which a mobile user is surrounded. The underlying technological requirement for this feature is the possibility to locate a mobile device through global positioning system (GPS). An example of context in terms of an airport environment would be the release of a boarding pass as a traveler approaches the airport. Context is closely related to what is often referred to as data proactivity. Flight paging applications, where a traveler receives information based on context (flight X is delayed) without having to actively request such information (data pro-activity), is a typical example. In order for mobile technology to add value, it must tackle compromises inherent in business processes. The following table shows an example for airline processes in an airport environment.

**TABLE 1: Technology Value Contribution** 

Break Compromise		Booking Reservati		Check in	Wait for Depart.	Board Flight
		Availability Schedule Waiting Time	Time, In- convenience	Waiting in line	Un- Productive time	Waiting in line
	Ubiquity	X	Х	Х	X	X
Technology Value Contribution	Context	Х	X	Х	X	X
	Data pro-activity	Х				X
	Pay function	Х			Х	
	Interaction	Х			Х	
Tect C	Entertainment				X	
- Som	Remote Control	X	Х	X		X

Based on Zoebel (2001), 287.

The attribute of location has particularly aroused enthusiasm among consumer marketers. The location function has even gained its own name, L-commerce. However, besides a range of opportunities in connection to this feature, there is also a potential threat as the level of tolerance for "spam mail" and unwanted "push content" is likely to be significantly lower as compared to the wired Internet. 17

<sup>15 &</sup>quot;L-Commerce: The good, the bad, and the ugly", Financial Times, Sept. 18, 2001.

<sup>&</sup>lt;sup>16</sup> Push content is information that is displayed on a customer's handheld device without him/her actively requesting it; in contrast to pull services, which the customer has to request.

<sup>&</sup>lt;sup>17</sup> "Message to M-Marketers: Don't be Pushy", Wireless Newsfactor, September 18, 2001.

#### C.1.5 M-Business Value Chain

The m-business value chain is composed of five critical elements, which are infrastructure, network operators, content, applications, and portals. The development of an efficient infrastructure, being the first element, includes device manufacturers and vendors, network service providers, software developers, system integrators, and wireless application providers. An example of companies predominantly engaged in this segment of the value chain is Ericson and Motorola, who manufacture devices and build network infrastructure in terms of communication satellites and radio access networks (CDMA, GSM, GPRS, etc.).

The most leverage in the m-business chain is attributed to companies active in the second element, network operators such as Sprint PCS, Verizon, and Voicestream. These wireless carriers can choose to either operate their own network, or to function as virtual operators purchasing network capacity from primary operators and selling it under their own brand name. An example of this would be the British company Virgin Mobile, which uses its Virgin consumer brand to provide service using network capacity from a primary network operator. One2One. 18 Network operators have a dominant position in the m-value chain because they provide the touch points with customers. This makes it possible to charge users directly for the use of services through the monthly phone bill. Operators also have access to customer information, including localization data. Furthermore, operators incorporate revenues for every transmission of data. whether charged by the amount or by time.

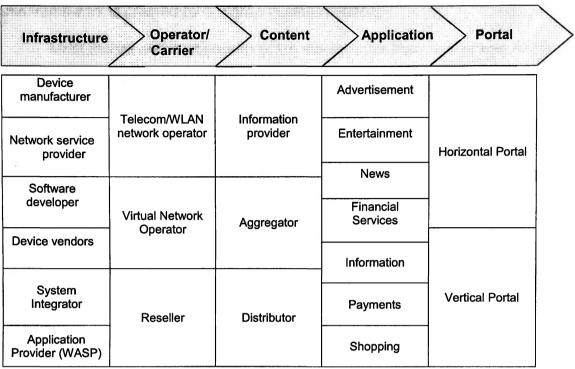
<sup>&</sup>lt;sup>18</sup> Owned by Deutsche Telekom.

The third element is the provision of mobile content. This can be subdivided into three basic functions. One is to provide content directly in terms of information. A second function is to collect content from different application providers customizing it to different devices (mobile phone, PDA etc.). A third function is to distribute content in the form of a mobile gateway. The role of gateways is to translate Internet content into wireless content and sending it "onair".

Mobile applications present the fourth element in the m-value chain. Frequent applications are advertisement, entertainment, news, financial services, information, and the function to execute payments, which in turn allows wireless shopping.

The final element of the value chain is the function of mobile portals. In general terms, a portal is a service designed as central starting point for the use of wireless devices. A portal can provide a portfolio of mobile applications from different providers, which has the potential to generate value to users given, the difficulties to navigate through WAP pages. Portals can be distinguished as being horizontal or vertical. While horizontal portals seek to provide a rather general and broad scope of applications and services, vertical portals target special user segments providing in-depth information in a particular area or field of interest. The following figure presents the mobile business value chain as described above.

Figure 2: The M-Business Value Chain



Based on Mobile Business, 122.

#### C.1.6 The mobile business model

A business model in general describes the way in which a company intends to generate profits. In order to construct the business model, at least three basic factors need to be considered. These factors are sources of revenue (or profit), the unique selling proposition, and the customer segment. Each element has to be embedded into an overall strategy providing the

<sup>&</sup>lt;sup>19</sup> These factors are independent and comprise only of the most immediate influences. Including more variables could make the model more realistic, yet would also increase complexity, which is not intended at this point.

framework for each of the variables mentioned before.<sup>20</sup> Applied to this thesis, this framework is created by a mobile business strategy.

Most mobile airline applications are available for business as well as for leisure travelers. Since customers need to possess a mobile device, it can be argued that mobile applications mainly target customers in the business and frequent flyer segment.

The first profit source in the mobile model is based on increased customer satisfaction and loyalty, given the underlying assumption that increased satisfaction leads to increased revenues. The second profit source is associated with cost reductions through the streamlining of business processes. Most frequent m-business applications focus on information. For the airline industry, the revenue stream is fairly indirect (through increased loyalty). Network operators charging for airtime will capture the major portion of tangible revenues. This has led to an interesting partnership between content providers and cellular companies. Northwest Airlines, Travelocity, and United Airlines are content providers for Verizon Wireless. Expedia and Sabre provide content for Cingular.

The unique selling proposition (USP) is typically the reason an entity exists and is essential to differentiate products from competitors. In order to be successful, a USP should propose a benefit to the customer, it needs to be unique in a way that it cannot be easily replicated by competitors, and it has to be

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<sup>&</sup>lt;sup>20</sup> Zoebel (2001), Mobile Business und M-Commerce, 201.

<sup>&</sup>lt;sup>21</sup> "Looking for the Pot of Gold", The Economist, October 13., 2001.

<sup>&</sup>lt;sup>22</sup> www.verizonwireless.com

strong enough to attract new customers.<sup>23</sup> The selling proposition for m-business made by airlines can be derived from the "branding" of products in the wireless service portfolio. American Trans Air, for example, calls its line of services "straight to the gate". United has created the term "United2G0". Sabre refers to its wireless product as "virtuallythere", and Alaska Airlines named its services "Alaska.anywhere". In summary, the most common unique selling propositions (USP) center around ubiquity and convenience.

Customer segment, profit sources, and selling proposition seem to be defined in the airline mobile business model. Yet, the underlying framework, the strategy, is not quite obvious. When airlines describe the objectives driving their wireless service innovations, most claim customer satisfaction and cost reduction as their main goals. Cost reduction, however, is not necessarily a long-term strategy; it may barely be a tactic.<sup>24</sup> Cost reduction may increase operational effectiveness. This will lead to a "new best practice" in the industry, quickly adopted by competitors.<sup>25</sup> The relatively small variation in current mobile applications in the US airline industry supports this argument. (For a more detailed analysis, please see section "competitive environment- airlines", 2.2.)

# C.1.7 M-Business Outlook

The use and availability of handset-based applications is expected to increase rapidly on the consumer, as well as on the business side. An In-Stat

<sup>&</sup>lt;sup>23</sup> Kotler, Bliemel (1999), "Marketing Management", 9<sup>th</sup> ed., Schaeffer Poeschel, p.496.

<sup>&</sup>lt;sup>24</sup> Porter (1996), "What is Strategy, Harvard Business Review, Nov.-Dec., 1996, 61. <sup>25</sup> Porter (2001), "Strategy and the Internet", Harvard Business Review, March 2001, 63.

survey drawn from a technology adoption panel suggests that 45 percent of current WAP users have purchased products via handheld devices. Products most frequently purchased are books and airline tickets.<sup>26</sup> The future revenue stream from mobile business services in the US is expected to focus on mobile intranet and extranet. In contrast to other regions, especially Western Europe and Asia, the demand for infotainment in the US market is estimated to be comparably low, accounting for only 9 percent of revenues by 2010. Yankee group, a research firm based in Boston, predicts that 50 million US wireless phone users will purchase premium content and physical goods by 2006, generating revenues of \$ 15 billion.<sup>27</sup> Other forecasts for m-business are less optimistic. A study conducted by Meta Group suggests that only one-fifth of business to consumer transactions will be wireless and mobile by 2003.<sup>28</sup>

Recent terrorist attacks have imposed a tremendous threat on the growth of mobile business in the US airline industry. Yet, on the other hand, they also present a substantial opportunity. Either scenario is associated with airport security, in particular with biometrics. Wireless check-in applications, for example, have to comply with FAA security standards. Before the September 11 attacks, this was performed through a biometric voice recognition solution. If this procedure will suffice with new FAA standards and additional biometric solutions can be integrated into the mobile process chain, m-business can create increased value by reducing waiting time and inconvenience at airports. But in

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<sup>&</sup>lt;sup>26</sup> CDG: Statistics and forecasts (www.cdg.org/applications/statistics.asp).

<sup>&</sup>lt;sup>27</sup> "Report: Mobile Commerce Set for Growth Spurt", Wireless NewsFactor, Oct. 31, 2001.

<sup>&</sup>lt;sup>28</sup> "Study: M-Commerce Faces Slow-Growth Future", Wireless NewsFactor, Sept. 14, 2001.

the case that voice biometrics will be perceived as an insufficient identification feature, process-oriented mobile applications are potentially threatened.

# **C.2 TECHNOLOGICAL ENVIRONMENT**

In order for airlines to implement a mobile business strategy successfully, it is necessary to understand technological capabilities of each element in the mobile process chain. Three main elements should be considered. First, content has to be made available. This refers to the technology in place to transmit data, as well as to the markup language and protocol in place to receive and display mobile content. Secondly, there must be an adequate infrastructure in place. This issue addresses the availability, speed, and capacity of wireless networks and air interfaces. And third, mobile customers need to have the necessary devices with adequate capabilities to perform mobile business tasks.

#### C.2.1 CONTENT TRANSMISSION

# C.2.1.1 <u>Data Transmission Technology</u>

There are two different basic types of data transfer systems, circuitswitched and packet switched networks. Current 2G systems employ a circuit
switching technique, which means that a channel has to be reserved for the
entire duration of a call. This transmission technology has significant
disadvantages with respect to mobile commerce applications. Since users
occupy a channel for the entire time a device is online and wireless carriers
charge their customers by airtime, data transfer in such environment is relatively

expensive. This has been one of the main problems with the first generation of WAP (WAP 1.0). Users have to pay regardless of whether information is received or not, which is aggravated by the low data transfer rates in 2G networks. In order to conduct business transactions via a wireless device, it is important to limit the time to download data, as well as the associated costs. This can be achieved by introducing a system that allows transmission of data packages (packet switching). This allows users to remain connected to the wireless web also when no data is transmitted. Unlike circuit switched systems, users are charged for the amount of data sent or received rather than for the time the device is "on-line". This function is referred to as "always-on". The packet data switching models function similar to the current Internet. Data, including voice, is broken down into digital data packages, which are sent through channels randomly and reassembled at the destination.<sup>29</sup>

Packet-switched data transfer is implemented in 2.5G technology, which became available in the fall of 2001. However, there are also carrier specific packet switched networks available in first- and second generation Telecom Networks. Examples of this are AT&T's "CDPD", BellSouth's "Mobitex", and "IDen" offered by Nextel. These networks operate in the public terrestrial radio spectrum. Main disadvantages are relatively slow transmission rates (9-19 kbps) and lack of coverage outside urban areas.<sup>30</sup>

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<sup>&</sup>lt;sup>29</sup> Zoebel, (2001), Mobile Business und M-Commerce, 259.

<sup>&</sup>lt;sup>30</sup> Wittmer (2001), Wireless Business & Technology, November 2001.

# **C.2.1.2 Wireless Protocols**

The wireless application protocol (WAP) refers to a set of rules that define the exchange of data between a mobile device and a communications network. The WAP Forum, which is an industry association, has developed WAP as an open standard that is compatible with most wireless networks (CDMA, TDMA, GSM, etc.). It functions independently from the operating system of a wireless device (such as Palm OS, Windows CE). The WAP Forum consists of about 500 companies among which are handset manufacturers, wireless carriers, infrastructure providers, as well as software and application developers. The first version of the wireless protocol (WAP 1.0) was released in 1998 with the final goal to establish Internet compatibility. The main difficulty in achieving this is attributed to the limited screen of digital mobile handheld devices and to the low data transfer rate in current communication networks (9.6-14 kbps).

Some PDAs are already equipped with enough memory to load HTML pages. However, in order to display Internet content effectively on a mobile device, it is necessary to transform web pages into a format that can be displayed adequately given technical constrains and size of the display. This is achieved by converting web pages into a simpler markup language (WML). Thereby, devices equipped with a micro browser can access content from mobile portals. The advanced version of WAP (WAP 2.0<sup>32</sup>) added common Internet

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<sup>&</sup>lt;sup>31</sup> WAP Forum (www.wapforum.org).

The WAP Forum released WAP 2.0 in August 2001 for public review.

technology such as IP (Internet Protocol) and TCP (Transmission Control Protocol), which allow further integration with the Internet.<sup>33</sup>

A competing technological standard is I-mode. This protocol was developed by the Japanese telecom giant NTTDoCoMo. In contrast to WAP, I-mode is based on a simplified version of HTML called compact HTML (cHtml). NTTDoCoMo's success to establish a common standard in the Japanese market is mainly attributed to its dominant position as a former telecom monopoly. Despite attempts to export I-mode abroad, WAP is expected to remain the prevailing standard in the US.<sup>34</sup>

Figure 3: The WAP Model

Source: WAP 2.0 Technical White Pages, The WAP Forum

33 "WAP 2.0 Technical White Paper", The WAP Forum, August 2001.

<sup>34 &</sup>quot;WAP vs. I-mode", Wireless Business & Technology, September 2001.

# C.2.1.3 Wireless Markup Language (WML)

Since the current Internet standard markup language (HTML) is clearly limited and insufficient to display items on a small digital screen, a new wireless markup language (WML) was initiated to enable wireless devices to access content from the Internet. HTML describes how data is displayed graphically; the wireless markup language is rather based on the extended markup language (XML). HTML as well as XML describe the content of web pages. Yet, the focus of XML is to describe data in terms of the information it contains, which is a flexible way to create common formats and share the data as well as the information tags on the World Wide Web, intranets, and extranets. However, to assist the development of wireless Internet portals, content has to be translated from the HTML format into WAP-accessible WML pages. In order to make Internet content available for handheld screens, companies are assumed to spend \$78,750 on average in labor costs for the XML-formatting necessary to allow an application to run an a handheld screen.<sup>35</sup>

#### **C.2.1.4 Content Convergence**

There are two factors driving the trend towards convergence of mobile and Internet-based content. One factor is the improvement of the standard Internet language HTML with its current version of 4.0. The next generation of HTML will extend capabilities to define data also in terms of the meaning. Due to these

<sup>&</sup>lt;sup>35</sup> "The Cost Of Selling Online", The Forrester Report, July 2001.

extended capabilities, HTML 5.0 is also referred to as extensible HTML (X-HTML). Future generations of wireless applications and protocols (such as WAP 2.0) will be based on X-HTML, which would simplify translation of content into WML format. The other factor promoting content convergence is the improvement of wireless devices in terms of available memory, color screens, micro browsers, and processor speed.

#### C.2.2 WIRELESS INFRASTRUCTURE

# **C.2.2.1 Telecommunications Networks**

# C.2.2.1.1 First Generation (1G)

Mobile telecommunications in the US emerged from the Advanced Mobile Phone Service (AMPS), which is based on analog radio technology. It was developed in the Bell Laboratories in the mid-70s. After several service trials and an initial roll out in 1978 in Chicago, the system became fully operational in 1982. AMPS is also referred to as first generation (1G) wireless standard.<sup>36</sup>

# C.2.2.1.2 Second Generation (2G)

Second generation networks are digital, which means that analog voice inputs are modulated into numeric codes, in contrast to 1G technology. Current

<sup>&</sup>lt;sup>36</sup> V. C. Ramasami, "Advanced Mobile Phone Service- An Overview", University of Kansas, EECS Dept.

2G systems transmit digital signals based on a circuit-switching model, which as was mentioned above, has the disadvantage that a channel has to be reserved for the entire duration of a call. Second generation networks are superior over their analog predecessor in terms of capacity and speed of data transfer, typically reaching between 9.6 and 14 kilo bit per second (kbps). Wireless 2G phone service can be divided into cellular and PCS (Personal Communications Service), which is also a form of digital cellular service. However, PCS uses a different frequency spectrum that the Federal Communication Commission (FCC) made available to encounter increasing demand for personal communication. Unlike cellular phones, PCS operates in the 1900 MHz frequency range. PCS and cellular technologies use the same network standards as air interface. Three competing 2G-network standards exist in the US market: TDMA, CDMA, and GSM.

# C.2.2.1.2.1 TDMA/D-AMPS:

The most widely used mobile phone standard for second-generation mobile telecommunications in the US is digital AMPS (D-AMPS), 37 accounting for about 80 percent of end users.<sup>38</sup> Earlier circuit-switching technology required a single channel to be allocated to only one user at a time.<sup>39</sup> In order to increase network capacity, a new transmission technology called time division multiple

<sup>&</sup>lt;sup>37</sup> According to Ericson, DAMPS IS-136 is now called TDMA/IS-136.

<sup>&</sup>lt;sup>38</sup> GSM Association (www.gsmworld.com).

<sup>&</sup>lt;sup>39</sup> This technology is called Frequency Division Multiple Access (FDMA). TDMA is very similar to FDMA, yet it includes a time-sharing component.

access (TDMA) was implemented into the traditional AMPS infrastructure. TDMA increases network capacity by allocating time slots of a few microseconds to a number of users. As the frequency is divided by time, it allows multiple calls to be handled simultaneously via a single channel. First versions of TDMA allowed up to three calls to be handled simultaneously. Current versions have increased this number to six calls. 40 Further enhancements of this technology are planned in the near future. Capacities reaching 40 times the capacity of analog transmissions are discussed. A disadvantage of TDMA is that each adjacent cell in the network is required to have a different frequency in order to prevent interference. When mobile users roam from one cell site to the next, there is a chance of losing the connection. Opinions about the future of TDMA technology are split because the technology does not allow development into a 3G standard. Yet, network operators in the US forecast continued growth in TDMA-based services until 2004. This is attributed to the fact that the technology is viewed to be reliable and proven. TDMA is expected to remain the most prevalent standard in the US for the next couple of years.41

# C.2.2.1.2.2 CDMA

A competing technological standard is the code division multiple access (CDMA). Qualcomm, a company based in San Diego, developed the first version of this technology called CDMAone in 1989. It is based on a spread-spectrum

<sup>40</sup> International Engineering Consortium (IEC), "Time Division Multiple Access", Web ProForum Tutorials (http://www.iec.org).

<sup>&</sup>lt;sup>41</sup> "The TDMA operator path to GSM", Ericson White Paper, Sept 2001.

technology, which means that digital data is transmitted using multiple frequencies simultaneously. Unlike TDMA, where time slots divide a channel, the Code Division Multiple Access assigns a code to every data packet sent. The receiver is located through Global Positioning System (GPS) and receives a unique key, which allows the decoding of the message. Only a receiver that knows this key is able to respond and demodulate the signal. CDMA networks do not require the use of different frequencies in adjacent cells. This feature is referred to as "soft handoff", which decreases the chances of loosing a connection when moving from one cell site to another. In a one-channel version, the technology enables data transfer of up to 14 kbps in its current 2G version.

# C.2.2.1.2.3 <u>GSM</u>

GSM stands for "Global System for Mobile Communications" and was launched commercially in 1991.<sup>42</sup> GSM emerged through an initiative in Europe to create a common mobile standard for digital networks. Before this, Europe's analog networks were lacking compatibility, making roaming in other countries impossible. Today, GSM is the most widely used mobile system worldwide, accounting for about 70 percent of mobile users (over 500 million subscribers).<sup>43</sup> The main difference between GSM and D-AMPS networks consists of the techniques used to digitize analog voice signals. GSM employs a frequency, as well as a time division component (FDMA/TDMA). However, the TDMA standard

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<sup>&</sup>lt;sup>42</sup> J. Scourias, "Overview of the Global System for Mobile Communications, University of Waterloo.

<sup>&</sup>lt;sup>43</sup> "Cingular Tackles US Wireless Speed Barrier", Wireless Newsfactor, Oct. 31, 2001.

in GSM systems is not compatible with its counterpart in North American networks. A unique feature of GSM is the ability to send alphanumeric messages of up to 160 characters, called short messages (SMS). GSM has only played a limited role in the US market. One of the main operators is Voicestream. The first GSM network in the US was PCS1900, which is a subset of the original GSM standard. After TDMA operators, and possibly some CDMA operators switch to GSM to migrate to next generation technology, the GSM Association forecasts GSM's worldwide market share to increase to 85 percent.<sup>44</sup>

## **C.2.2.1.3** 2.5 Generation

The most important technological advances in 2.5G networks consist of increased speed of data transfer and the transmission of data in digital packages called packet switching (please see section "Transmission Technology"). Similar to the Internet, data transfer in 2.5G networks supports standard protocols such as TCP/IP. Data is broken down into digital packages that are randomly sent through channels and reassembled at the destination.<sup>45</sup> This allows users to remain connected to a mobile gateway and to be charged for the amount of data transferred rather than for the time spent online. This function is regarded as a major requirement for the take-off in mobile business. Depending on how well 2.5G networks can live up to their promises, it is likely that most Internet applications, as well as transmission of music and pictures, will already be available in this environment.

<sup>44</sup> "Nokia and AT&T Wireless Services Complete First Live 3G EDGE Call", Business Wire, Nov. 1, 2001.

<sup>&</sup>lt;sup>45</sup> Zoebel (2001), Mobile Business und M-Commerce, 259.

The term 2.5G refers to transition stages between 2G networks and "next generation" 3G technology. In TDMA and GSM based networks, 2.5 G refers to a packet switched system called GPRS (General Packet Radio Service), which is expected to reach data transfer rates of around 115 kbps. 46 Current data rates. however, are believed to reach only 25-40 kbps. An extension of GPRS is EDGE, which may further enhance data transmission speed to 384 Kbps. In CDMA networks, 2.5G is associated with a standards defined as 95B, an enhanced version of CDMAone (95A). CDMA 95B is also packet switched and offers data transfer rates that are below GPRS's theoretical speed. Advocates of CDMA, however, suggest that actual average data throughputs of 95B could outperform GPRS.47

#### C.2.2.1.4 Third Generation (3G)

3G refers to a framework of third generation mobile systems defined by the International Telecommunications Union (ITU)<sup>48</sup>. Its technical name is IMT-2000 (International Mobile Telecommunication), which defines the speed of data transfer as well as the technology interface. Third generation systems provide mobile users with broadband connectivity. Theoretical data transfer speeds reach 2 Mbps. The minimum required speed under all conditions is 144 Kbps in order for a network to be considered 3G. The availability of broadband transmission will

<sup>&</sup>lt;sup>46</sup> Mark Norris, "Mobile IP Technology for M-Business, Artech House, 2001, 232.

<sup>&</sup>lt;sup>48</sup> The ITU is a sub-organization of the United Nations (UN).

allow users to download audio and video clips. 3G systems also support Internet protocols (IP) and provide wireless users with an "always online" function.

According to the IMT-2000 standard, which initially proposed to merge existing standards into one, there are presently two standards described. For third generation network operators this will be CDMA2000, which is based on the prior CDMAone standard. The standard described for third generation infrastructure in Europe's GSM network is referred to as UMTS. <sup>49</sup> The European Standardization Organization has set UMTS as the prevailing standard for GSM networks. It is expected to use a wideband version of CDMA called W-CDMA.

The revenue potential expected from 3G systems is reflected in the vast amounts of investments realized by telecom operators in order to acquire licenses for radio spectrum. In the UK for example, five licenses were auctioned for \$36 billion. These investments, however, have left many analysts in doubt whether a breakeven will occur in the medium term future, or ever. In the US, 3G networks are planned to be operated in the PCS spectrum and in the spectrum currently used by cable TV stations. These frequency spectrums are due to be released. However, the auction was postponed but has been rescheduled for June 2002.<sup>50</sup>

Even 4G networks are currently tested in laboratories. Data transfer rates are said to reach up to 20 Mbps.<sup>51</sup>

<sup>&</sup>lt;sup>49</sup> Universal Mobile Telecommunications Standard (UTMS).

<sup>&</sup>lt;sup>50</sup> "U.S. Sets Date for Wireless Spectrum Auction-Again", Wireless NewsFactor, Oct 17, 2001.

<sup>&</sup>lt;sup>51</sup> Zoebel (2001), Mobile Business und M-Commerce.

## C.2.2.2 Carriers

The major telecommunication carriers in the US market are Verizon,
Cingular, AT&T, and Sprint PCS, for a combined market share of about 75
percent. The list of smaller carriers includes Nextel, Alltel, and Voicestream.<sup>52</sup>
Mergers among the major companies are not expected within the next three
years, which is due to the slow pace of industry deregulation initiated in 1996.<sup>53</sup>
The number of wireless subscribers in the US is expected in increase by an
annual rate of 11.8 percent until 2005. By then, the number of wireless users
would reach a total of 191 million, about 67 percent of the US population.<sup>54</sup>

#### C.2.2.2.1 Verizon Wireless

Verizon Wireless serves a client base of around 28 million mobile phone subscribers and 3.5 million paging customers, which makes it the market leader in terms of customer share. The company was created by a merger of companies controlled by Bell Atlantic and Vodafone and began operations in 2000. Verizon Communications holds a 55 percent controlling stake, the remaining 45 percent are owned by Vodafone. <sup>55</sup> Verizon's network employs CDMA technology, which is also chosen for the implementation of the 3G standard (CDMA2000).

<sup>&</sup>lt;sup>52</sup> Wireless Landscape, New York Times, Oct. 8, 2001, C3.

<sup>53 &</sup>quot;Telecom Deals unlikely in the US", Financial Times, Oct. 26, 2001.

<sup>&</sup>lt;sup>54</sup> "US Wireless Industry to Reach 60 percent penetration in five years", Wireless Today, Oct. 12, 2001.

<sup>55</sup> Hoover's company Capsule www.hoovers.com.

## C.2.2.2. Cingular

Cingular is a joint venture between two Bell companies (Bell South and SBC Communications). Being the second largest telecommunications carrier, Cingular operates a TDMA/AMPS based network as well as a GSM network. The company is pursuing the GSM/GPRS path towards 3G. GPRS service has been already available in Washington State. Recently, the company announced the roll out in further selected markets, mainly located on the southeast coast. <sup>56</sup>

#### C.2.2.2.3 AT&T Wireless

With its 16.4 percent share in the domestic market, AT&T Wireless is the third largest operator. After it was spun off on July 9, 2001<sup>57</sup> from its parent company, Japan's NTT DoCoMo has bought a 16 percent stake as part its oversees investment strategy. <sup>58</sup> AT&T has been operating a TDMA network. The carrier is currently preparing to implement GSM in order to migrate to 3G. AT&T has chosen the GSM/GPRS path leading to WCDMA, which is the standard prescribed for UMTS. Through the adoption of the GSM path, the company expects to benefit from GSM's high worldwide market share of about 64 percent. This will improve roaming capabilities, which is seemingly a competitive advantage over CDMA operators. The launch of the 2.5G network, which will

<sup>56</sup> "Cingular Wireless to Deliver 2.5G Wireless Service to Consumers in the Southeast and Las Vegas", PR Newswire, Oct. 25, 2001.

<sup>&</sup>lt;sup>57</sup> "Nokia and At&T Wireless Services Complete First Live 3G Edge Call", Business Wire, Nov 1, 2001.

<sup>58 &</sup>quot;World Watch", The Wall Street Journal, Jun. 27, 2001, 8.

employ GPRS based packet data transmission, is scheduled towards the end of 2001.<sup>59</sup> User fees are planned to be \$50 per month.<sup>60</sup>

## **C.2.2.2.4** Sprint PCS

Sprint PCS<sup>61</sup> is currently the fourth largest carrier, yet was ranked first in customer growth in 2001. Sprint is one of the main operators in the PCS (Personal Communication Service) spectrum. The carrier has built up its network based on second generation CDMA technology. The migration path selected towards the third generation IMT-2000 standard will encompass 4 stages leading to CDMA2000. Sprint plans to launch the first phase (version 1x) of 3G between late 2001 and mid-2002. By implementing this version, Sprint expects to increase data transmission speed to 144k per second. Further features include double network capacity and packet data transmission technology. Sprint claims to be able to harvest significantly lower costs for the migration to 3G compared to GSM and TDMA operators because the carrier can use existing spectrum and build upon its present network technology. In order to upgrade its network, Sprint handed out a contract over \$2 billion in of June 2001.<sup>62</sup>

<sup>&</sup>lt;sup>59</sup> AT&T News Release, "AT%T Wireless on Target to Deliver 3G Services", July 17, 2001.

<sup>&</sup>lt;sup>60</sup> GPRS was already rolled out in July 2001 in Seattle as test market.

<sup>&</sup>lt;sup>61</sup>Based on information provided on Sprint's homepage at www.sprint.com/wireless <sup>62</sup> "Report: Profits won't keep pace with wireless explosion", Wireless NewsFactor, July 17, 2001.

## C.2.2.3 Wireless Local Area Networks (WLAN)

Wireless Local Area Networks are flexible communication systems. Using radio frequency technology (RF), WLANs transmit and receive data over the air, which provides users with the dual benefit of connectivity and mobility. Wireless Local Area networks are frequently employed in the process chain of airports as well as airlines. On the passenger side, these applications include curbside check-in, mobile ticketing and check-in counters, and self-service kiosks. Sabre's Roving Agent application employs a WLAN that enables service agents to connect to airline's area network using a handheld device. Mobile check-in units are, for example, in use by United Airlines, connecting terminals installed at mobile counters to United's check-in and boarding system. Another frequent application of wireless LAN architecture is to allow airline customers to connect to the Internet using a wireless network card. US airlines have been offering this service increasingly especially at airport lounges at large hub airports. 63 Since WLANs offer data transfer of up to 11 Mbps (which is about 200 times faster than a common dial-up modem), business travelers have embraced this service. The leading wireless Internet service providers (WISP) at US airports are Wayport and MobileStar.<sup>64</sup> MobileStar is installed at 23 airports and American Airlines lounges, while Wayport offers service at four US airports. 65

<sup>&</sup>lt;sup>63</sup> Economist, Oct 13<sup>th</sup>, 2001, p.8.

<sup>&</sup>lt;sup>64</sup> The company has declared bankruptcy and was acquired by VoiceStream of Deutsche Telekom.

<sup>65 &</sup>quot;Wireless wonders" Airport World, Vol. 6, Iss. 4, August/September 2001.

Other frequent applications of wireless LANs can be found in onboard services, Operations, and Ramp and Cargo Handling. American Airline's cargo tracing application, for example, allows ramp agents loading an aircraft to use wireless devices to scan cargo labels in order to confirm destination, store loading information (container number, position), and transmit this information to the airline's central computer system through RF.<sup>66</sup>

The most frequently used architecture for wireless local area networks in the aviation industry is wireless Ethernet. In order to promote compatibility among technology vendors, the IEEE pronounced a common industry standard called 802.11b. Due to its somewhat unpleasant name, the 802.11b protocol is also referred to as Wi-Fi (wireless fidelity) in the industry.

For the use in an airport environment, the WLAN architecture has also evoked concern with respect to security and possible interference. A discussion has been going on whether this technology provides enough security measures to prevent interception of wireless data transfer, particularly where such data is mission critical or confidential. <sup>67</sup> Interference of radio waves by WLANs is attributed to the fact that most popular solutions operate in a frequency range (2.4GHz), not regulated through frequency licenses by the Federal Communications Commission (FCC). Thus, interference may occur with other wireless networks, as well as with devices such as cell phones, which occupy the same frequency spectrum. In order to guarantee compatibility among different wireless LANs in use at airports and to prevent interference, airports are facing

<sup>67</sup> Stephan Somogyi, "802.11 and Swiss Cheese", ZDNN, April 2001.

<sup>&</sup>lt;sup>66</sup> E. M. Melendez, "Wireless LANs", Passenger Terminal World, 2001, 144-147.

the important task of defining common industry guidelines for the implementation of WLANs in public access areas.<sup>68</sup>

An interesting development creating opportunities for WLANs is the capability to substitute for telecommunication infrastructure in densely populated areas. NTTDoCoMo, for example, is currently conducting a trial project where wireless customers connect through a WLAN infrastructure. Voicestream has showed initiatives to implement WLAN infrastructure in a corporate environment in the US market.<sup>69</sup>

#### C.2.2.4 Bluetooth based Networks

Bluetooth is a standard for data transmission that is based on infrared technology. The protocol is referred to as 802.15. It was first developed by a consortium of companies consisting of Ericsson, Intel, Nokia, and Toshiba.

Bluetooth enables wireless data transfer at a rate of up to 1 Mbps<sup>70</sup> between devices. Since the reach of Bluetooth is rather limited to a radius of up to 30 feet, this network architecture is also called personal area network (PAN). This allows new applications such as interaction among devices, among people within reach, as well as interaction with machines and shops. By exchanging information between smart devices, Bluetooth can also provide a basis for

<sup>&</sup>lt;sup>68</sup> "Neutral Wireless LAN Architecture", ARINC, 2001.

<sup>&</sup>lt;sup>69</sup> WirelessNewsfactor, March 22, 2002.

<sup>&</sup>lt;sup>70</sup> This resembles about 5-10 percent of the rate common for WLANs.

<sup>&</sup>lt;sup>71</sup> Zoebel (2001), Mobile Business und M-Commerce, 263.

payment transactions by addressing a device located anywhere within reach.<sup>72</sup> The function of executing payments via an infrared connection has also been labeled "M-Cash". It has created interest especially among credit card companies. 73 A disadvantage of Bluetooth is that it is completely different from WLANs from a technological perspective. Operators need to set up a new network, which incorporates high costs and risks. The main problem with respect to this technology is that only few applications are currently available. This results in slow increase of network usage, which in return slows down availability of applications. In recent months, however, it appears that Bluethooth has gained increased industry support.<sup>74</sup> Microsoft, for example, has decided to embed this standard into its windows XP operating systems. Also Qualcomm's new "Brew" platform for handsets supports the 802.15 standard. 75 Despite its various potential areas of application, Bluetooth has not gained significant importance in the Airport environment. Ericcson is one of the few vendors of Bluethooth based solutions for the transportation and airport industries offering mobile ticketing and information. <sup>76</sup> The company points out the lower investment cost for this network type as compared to common WLANs. Several US airports have been considering the implementation of Bluetooth technology in the near future.77

<sup>&</sup>lt;sup>72</sup> Mobile Business und M-Commerce, 41.

<sup>&</sup>lt;sup>73</sup> Nokia and Visa are currently elaborating on a dual-chip allowing secure wireless payments.

<sup>&</sup>lt;sup>74</sup> "Bluetooth Gets Microsoft Nod, Eyes Desktop PC Market" Wireless Newsfactor, Dec. 12, 2001.

<sup>75 &</sup>quot;Qualcomm Drives Next-Gen Handset Advances", Newsfactor, April 12, 2002.

<sup>&</sup>lt;sup>76</sup> http://www.ericsson-consulting.de/d3-7-5.htm.

<sup>77 &</sup>quot;What does "e" Mean to Me?", Handbook of Airline Strategy, McGraw-Hill, 2001, 395.

#### C.2.3 WIRELESS DEVICES

Besides the telecommunications infrastructure, which creates the necessary means to transmit content to a remote user, capabilities as well as availability of wireless devices have an immediate impact upon m-business possibilities. If the target group for a mobile application does not possess a wireless device, or if the device is insufficient to display the content, a mobile business strategy will fail. In the near future, new technologies such as touch screens, handwriting and voice recognition, as well as capabilities to run standard software applications are likely to have tremendous impact on the interface between humans and computers. This will most likely lead to a significant increase in use of wireless devices. The technological trend shows convergence of capabilities among mobile devices.

The following section will describe capabilities and spread of wireless devices common for m-business applications in the US airline industry:

- Mobile phones
- Personal Digital Assistants (PDA)
- Pagers
- Smart Cards

<sup>&</sup>lt;sup>78</sup> Norris (2001), Mobile IP Technology for m-business, Arttech House, 238.

## C.2.3.1 Mobile Phones

The annual survey conducted by Frequent Flyer Magazine (presented in detail in section "Airline Quality and Satisfaction" C3) reveals that 69 percent of US business travelers take their cell phone on trips. This figure has decreased from 83 percent in 2000. Wireless phones that are equipped with a compatible micro browser can display Internet content translated into a simplified markup language (cHtml, WML). Wireless content can be received using the wireless application protocol (WAP) or I-mode. If compatible with 2.5G packet switching technologies, cell phones can transmit voice via second-generation infrastructure, and receive packet data using GPRS or CDMA technology. An important issue with respect to mobile phones is backward and forward compatibility with next generation infrastructure. CDMA operators claim that handsets can be used in prior 2G networks as well as in upgraded networks (2.5G/3G). The GSM/UMTS path requires new handsets for every new level of upgrade. Another consideration is the compatibility with different network technologies. Dual-standard phones offer users the flexibility to use GSM and TDMA networks with the same device.<sup>79</sup> CDMA and GSM/GPRS infrastructure. however, will remain incompatible. Mobile phones are by far the most widely available device. According to a study conducted by Gartner Dataguest, 64.3 million US residents, representing nearly 61 percent of all households had at

<sup>&</sup>lt;sup>79</sup> "The TDMA Operator Path to GSM", White Paper, Ericson, September 2001.

least one mobile phone as of June 2001.<sup>80</sup> Yankee Group estimates the number of US wireless phone users to be 120 million.<sup>81</sup> An interesting development with respect to m-business is the integration of dual-chips, which allow mobile phone users to execute payment functions.<sup>82</sup>

#### C.2.3.2 PDAs

Personal Digital Assistants (PDAs) have evolved from being plain digital address books into multifunctional organizers. Recent models are equipped with 64MB of memory, which allows the use of standard software such as MS Office, Messenger, and Outlook. The first PDAs became available in-mid 1990. Unit sales are estimated to have increased by 50 percent in 2000. Despite the recent economic slowdown that has impacted PDA sales in 2001, sales revenue could top five times the current figures by 2006.<sup>83</sup>

Palm is the market leader accounting for a share of about 66 percent in the US- compared to 40 percent worldwide.<sup>84</sup> Other dominant manufacturers are Handspring, Compaq and Hewlett-Packard. All of Palm's handhelds are equipped with its own Palm OS operating system. In terms of the platform, the main rival is Microsoft's Windows CE system, which allows downscaled versions

<sup>&</sup>lt;sup>80</sup> "U.S. Consumers Migrating Towards Broadband, Wireless", Wireless Newsfactor, September 19, 2001.

<sup>&</sup>lt;sup>81</sup> "Report: Mobile Commerce Set for Growth Spurt" Wireless NewsFactor, Oct. 31, 2001.

<sup>82 &</sup>quot;Nokia, Visa, Test New M-Commerce System, Wireless NewsFactor, September 2001.

<sup>&</sup>lt;sup>83</sup>Art Pfennig, "PDA Revenue to Increase Fivefold By 2006, Internet Week, Oct 22, 2001, 39.

<sup>84 &</sup>quot;Battling for PDA market share", Wireless Week, Apr. 9, 2001, 20-21.

of MS Office to be used on equipped devices. Microsoft has recently released a new operating system called Pocket PC, which is based on Windows CE 3.0. Features that make Pocket PC especially interesting for business customers include the ability to access corporate area networks and intranets through a wireless connection and compatibility with standard business tools. Within the last year, Microsoft has been able to increase its market share from 16 to 23 percent supporting industry expectations that no single operating system will dominate the US market.

Given the potential for data processing capabilities, Police and Fire departments are currently debating whether or not to make PDAs available for officers to access police databases, report crimes, and track firefighters. <sup>86</sup> In the airport environment, PDAs are used by loading agents to scan and track cargo and baggage. On the passenger side, PDAs are used to check-in passengers and issue boarding passes away from fixed check-in counters. Twenty percent of US business travelers are estimated to take along PDAs when traveling. Yet, only 2 percent of them have PDAs equipped with wireless modems. <sup>87</sup>

## C.2.3.3 Pagers

Pagers are still a widely used device in the US market. The number of US business travelers indicating to take pagers on trips was found to be 18 percent according to the latest Frequent Flyer Magazine survey. A slight decline by 2

85 "Battles Ahead in Volatile Market", Financial Times, Oct 17, 2001, p.11.

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<sup>&</sup>lt;sup>86</sup> "Palm Device Gives Public Safety a Hand", Wireless News Factor, Oct. 22, 2001.

<sup>&</sup>lt;sup>87</sup> JD Powers and Frequent Flyer Magazine Survey, 2001.

percent could be noted compared to the year before. The dominant manufacturer is Canada-based RIM (Research In Motion). Its most frequently used model is BlackBerry, which is a two way pager capable to download e-mails received in WML format. Unit sales have slightly decreased from last year. RIM pagers are equipped with up to 8MB memory and operate in packet switched PCS networks, which supports an "always-on" function. Pagers compatible with GPRS technology are available in Europe, and are likely to be introduced in the North American Market as GPRS becomes more widely available. Pagers have also gained in importance in the wake of September 11<sup>th</sup> events. In order to guarantee information flow in emergencies, US Congress members were equipped with Blackberry pagers.

## C.2.3.4 Smart Cards

Smart cards are plastic cards containing a memory chip capable of storing digital information such as identification numbers (PIN) and biometric data. Smart cards can serve as a platform to execute payments and can provide a "virtual cash" function, which creates an interesting application with respect to mobile commerce. Executing payments irrespective of location via smart cards would avoid transaction charges for credit cards, which are especially problematic with

<sup>88</sup> http://www.zdnet.com/zdnn/stories/news/0,4586,5095262,00.html.

<sup>89</sup> www RIM com

<sup>&</sup>lt;sup>90</sup> "Charting Wireless Industry's Course after Sept.11", Wireless Data News, Potomac, October 10, 2001.

respect to micro-payments (payments less than 1\$).91 Several airlines have implemented Smart Cards in order to increase customer service and reduce costs through process automation. 92 Smart Cards have also been tested in other areas of the travel chain, such as immigration control. Attempts have been made by IATA and ATA<sup>93</sup> to define a common standard for the use in the airline industry.94

Smart cards can be classified by their range. Low-Range Proximity cards are capable of transmitting data within a 10 cm radius (4 inches). Long-range cards increase the radius to about 20 meters (66 ft.). Since mobile business processes would naturally require data transfer over larger distances, Long-Range cards seem to be the only feasible media. The technological difficulty resides in the fact that long-range cards require a RF-chip, a transmitter, and power supply from a battery. This increases the card's width making it incompatible to commonly used reading devices, which are crucial for back up in case of system failure. The strategic risk associated with smart cards arises from the advance of the telecommunication infrastructure. In order to provide mobile applications through smart cards, a costly new low frequency RF network would have to be set up. Yet, when packet data transmission and increased transfer rates become widely available, this infrastructure would become obsolete due to the numerous disadvantages smart cards have compared to other handheld devices.

<sup>91</sup> Norris (2000), Mobile IP Technology for M-Business, 143.

<sup>&</sup>lt;sup>92</sup> David Dingley (1998), "Technology: Its effects on Travel Distribution and Service", Handbook of Airline Marketing, pp.459-469.

<sup>&</sup>lt;sup>93</sup> Industry Association of US Airlines (ATA).

<sup>&</sup>lt;sup>94</sup> IATA Resolution 791 and ATA resolution 20.204, effective June 1997.

In the current discussion focusing around airport security, it is likely that smart cards will be chosen as a preferred means to incorporate biometrics as means to expedite security checks. In terms of mobile check-in applications it appears that smart cards are the preferred device for carriers targeting a niche of premium customers.

Mobile devices described above clearly differ with respect to technologies employed and capabilities. However, the current trend for mobile devices points towards technological convergence. This leads to the emergence of "hybrid" devices. Examples of hybrids are smart phones, which combine the capabilities of a mobile phone with the organizer and address book feature of PDAs. Other common hybrids are PDAs that allow making calls and sending e-mail<sup>95</sup> or PDAs containing smart cards. PDAs able to use standard software could be viewed as hybrids between PCs and Organizers.

<sup>95 &</sup>quot;Excuse me, Your Handheld is Ringing", PC World, November 05, 2001.

### **C.3 COMPETITIVE ENVIRONNENT**

#### C.3.1 CUSTOMERS

With respect to customer focused m-business applications, the overall goal of an airline should be to use m-business as a tool for increasing customer satisfaction, which in return may yield loyalty and in consequence sustained profitability. As shown in the section "M-Business" (please see Technology Value Contribution, C.1.4), M-Business has the potential to address compromises inherent in current airline process chains. Therefore, it is crucial to determine what factors create such compromises, and how compromises are perceived by customers. This section will seek to elaborate the driving forces of customer satisfaction and service quality in an airline context.

### **C.3.1.1** Customer Satisfaction

## C.3.1.1.1 The Satisfaction-Loyalty Link

When conducting customer satisfaction surveys, many companies are content to see that their customers are satisfied with ratings averaging in the upper levels of a typical 1 to 5 point scale. However, satisfying customers may not be nearly enough. Jones and Sasser (1995)<sup>96</sup> argue that the gap between satisfied customers and completely satisfied customers can swallow a business leading to its fate. In a study analyzing the relationship between customer

<sup>&</sup>lt;sup>96</sup>"Why Satisfied Customers Defect" Harvard Business Review, Nov-Dec 1995, 88-99.

satisfaction and loyalty, data from 30 individual companies was reviewed. The companies belonged to five different industries, differing in customer relations and competitive environments. Intent to repurchase was chosen as a loyalty measure. The study found evidence that the relationship between customer satisfaction and loyalty is non-linear. Intensely competitive markets revealed that even a slight drop from "complete satisfaction" to "satisfaction" results in a drastic decrease in loyalty. Customers in monopolistic markets remained loyal regardless of their level of satisfaction. However, when the basis of the monopoly is removed due to deregulation, by the emergence of new technology or new market entrants, the curve describing the satisfaction-loyalty relationship can quickly adopt a shape common for competitive markets.

The airline market shows a mixed industry structure characterized by varying levels of competition and the existence of frequent flyer loyalty programs. Thus, achieving a high level of customer satisfaction is equally important for airlines. Frequent flyer programs may sometimes even cause completely dissatisfied customers to appear loyal. Yet customers, who were forced to loyalty by the lack of choice or by frequent flyer programs, can take revenge on routes that are competitive, typically when a new entrant approaches the market.

Therefore, it is essential for airlines to understand which portion of customer loyalty is generated artificially, and which portion can be attributed to offering a superior product. In order to achieve sustainable long-term loyalty effects,

companies have to provide services that significantly exceed customer expectations. 97

Even if a company has managed to implement a successful strategy that yields a high level of customer satisfaction, there are potential obstacles in terms of sustaining the satisfaction level. Audia and Locke (2000)<sup>98</sup> discuss the process of organizational change once a company has been successful with its business strategy. In a study between the airline and the trucking industry, the authors describe what they call the paradox of success. This paradox lies in the fact that as organizations achieve success, they tend to focus on the strategy that has worked in the past. As the environment changes, the persistence on past strategies can become self-destructive.<sup>99</sup>

## C.3.1.1.2 Customer Expectations

In order to increase customer satisfaction, it is important to understand the mechanism of creating value and benefits, and what price customers accept in return. According to microeconomic theory, the fair price customers are willing to pay is equal to the expected benefits they would derive from the product. Yet, from a marketing point of view, this relationship is not quite as simple since expected benefits are a function of a customer's expectations. What a customer expects from a company can vary significantly. In order to support the simple

<sup>97</sup> Larson (2000), Marketing Management, Winter 2000.

46

<sup>&</sup>lt;sup>98</sup> Audia, Locke (2000), "Successful Companies", Academy of Management Journal, Vol. 43, No. 5, 837-853.

<sup>&</sup>lt;sup>99</sup>Audia, Locke (2000), p.839.

economic relationship between price and benefit, a customer of a low fare airline such as Southwest would be assumed to have different expectations than a customer traveling on a full thrills airline, since prices charged by the respective airlines also differ.

Larson (2000)<sup>100</sup> points out that customer expectations are not static, especially in competitive markets. There are two main factors promoting expectations to change over time. Firstly, competition forces companies to improve their products continually. Thereby, customers become used to quality improvements over time and adapt their expectations to this trend expecting further improvements in the future. Secondly, customers do not distinguish their expectations by service or product categories. Thus, expectations of product improvements are transferred among companies and industries.

In an attempt to quantify influential elements of air traveler expectations, Proussaloglou and Koppelman (1999)<sup>101</sup> conducted mail and telephone surveys in the Chicago and Dallas area. The objective was to gain in-depth information about which factors influence the choice of airline, flight-, and fare class. Data obtained was then regressed in an econometric model. The study concluded that the provision of a frequent flyer program is a significant factor for travelers of both the business and leisure segments. Business travelers are willing to accept a premium of \$21 to choose a carrier offering the loyalty program in which they participate. If the program requires accumulating miles actively in a given time period, the premiums are \$52 for lower frequency business travelers and even

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<sup>&</sup>lt;sup>100</sup>Larson (2000), Marketing Management, Chicago, Vol.9, Iss.4, Winter 2000, 4-5.

<sup>&</sup>lt;sup>101</sup>K. Proussaloglou, F. S. Koppelman (1999), "The choice of air carrier, flight, and fare class", Journal of Air Transport Management, Vol.5, 1999, 193-201.

\$72 for frequent ones. Although the segment of leisure travelers also responds significantly to the provision of loyalty programs in terms of airline choice, these premiums are significantly lower. The accepted premium was found to be \$7. If the programs require mileage activity, premiums increased to \$18 and \$26, depending on travel frequency.

#### C.3.1.1.3 Satisfaction Measurement

One of the main challenges for measuring service quality resides in the problem of defining it. Commonly, quality is defined as the ratio of value over price. 102 The price of a service is easy to determine. Far more problematic is the measurement of value, or in more economic terms, utility gained. In order to generalize service quality, targeted customer groups need to share homogenous characteristics with respect to utility creation. 103 Mittal, Wagner and Kamakura (2001) 104 find that the link between customer satisfaction and loyalty expressed in repurchase behavior not only depends on market characteristics, but also on the customer himself. Characteristics that were found to be statistically significant are age, sex, level of education, and family status. Thus, in order to optimize overall customer satisfaction, companies should maximize performance on attributes that have the highest intrinsic value to customer in the corresponding segment, given the characteristics of the target customers group.

<sup>102</sup> Kellogg on Marketing

<sup>&</sup>lt;sup>103</sup> Kottler, P, Bliemel (1999), "Marketing Management".

<sup>&</sup>lt;sup>104</sup> Mittal, Wagner and Kamakura (2001), "Repurchase Intent", Journal of Marketing Research, Feb. 2001, 131-142.

In order to measure customer satisfaction in the airline industry, the target group needs to share homogenous characteristics with respect to service expectations. Two aspects need to be considered. First, who is the "typical" air traveler in the US market? Secondly, are expectations among travelers of different market segments homogeneous? According to a survey released by the Air Transport Association (ATA)<sup>105</sup>, the "typical" air traveler in the US who has flown in the last 12 months is male, between 35-54 (53%), has a household income of \$60,000 or more (70%), and lives in the western United States. The main reasons for flying are business related (45%), to visit family and friends (38%), and sightseeing (13%).

Most customer satisfaction surveys focus on a particular market segment such as frequent (business) flyers. In order to assume such sub-groups to be homogenous, however, it is also important to check for differences among travelers of airlines operating in different segments. Mason (2001) analyzed differences in customer expectations between business travelers using low-cost and full service airlines in the UK market. In a survey conducted at London Heathrow and London Luton airport, passengers were asked to rate the importance of service elements including punctuality, frequency, price, ticket flexibility, in-flight service, frequent flyer programs, and business lounges. Despite the fact that some attributes differ among travelers, the study concludes

<sup>&</sup>lt;sup>105</sup> Survey is available at the ATA web site www.air-transport.org, Percentage figures in brackets represent the percentage of respondents who fall into the respective categories. The population comprises travelers who have flown at least once within the last year.

that low-cost and full service cannot be assumed as two distinct market segments<sup>106</sup> in terms of consumer characteristics.

## C.3.1.1.4 Trends in Customer Service Strategies

Facing new products, technologies, and relationships with service providers, Wyner (1999)<sup>107</sup> identifies four critical factors to understand the future of customers. These factors are priority on customer wants, customer value, relationships, and information. The focus on customer wants is based on the assumption that priorities shift over time in response to changing preferences, tastes, environment, technology, and life style. The critical task pertinent to the focus of this thesis is to define latent needs that have not been fully formed. Customer value reflects the growing number of value propositions, which may lead to emphasizing brands. The increasing number of participants in the value chain getting in contact with customers redefines business relationships. In the travel industry, loyalty programs link car rental companies, airlines, and hotels to a network. The information focus reflects attempts by companies to generate information from their customers, which enable companies to segment customers more effectively and to determine their revenue potential. From a customer point of view this leads to the question whether or not they are compensated appropriately for the provision of information. Currently, customers lack power

<sup>&</sup>lt;sup>106</sup> Mason (2001), "Marketing Low-Cost Airline Service to Business Travelers", Journal of Air Transport Management, Vol. 7, 2001.

<sup>&</sup>lt;sup>107</sup>Wayner (1999), "The Future of Customers", Marketing Management, Chicago, Vol. 8, Iss. 3, Fall 1999, 8-10.

since their interests are not organized. In the future, the influence of customer interest groups may increase significantly.<sup>108</sup>

In order to adapt services to the changing technological environment,

Slwotzky and Morrison (2001)<sup>109</sup> suggest a shift towards digital technology for the
active customer. The active customer is characterized as an individual who
knows what he/she wants, favoring convenience and speed. The role of the
customer as economic subject has changed. Increasing competition and over
capacity in many markets has increased the customers' bargaining power. They
are less likely to settle for compromises and have become more active. This
becomes apparent by a trend to prefer helping themselves without having to rely
on a company's "talent". The authors suggest digital technology to be a strategic
tool to enable active customers to help themselves through e-commerce
applications, self-service kiosks, and automated telephone services. Such digital
business designs would increase customer satisfaction and allow a company's
workforce to focus on high level skills rather than on the performance of routine
transactions.

#### C.3.1.1.5 Customer versus Innovation Focus

Berthon, Hulbert and Pitt (1999)<sup>110</sup> identify two distinct business philosophies. One is consumer orientation, the other innovation orientation. A

108 Wayner (1999), "The Future of Customers", Marketing Management.

<sup>&</sup>lt;sup>109</sup>Slwotzky and Morrison (2001), "The Digital Customer" Marketing Management, Chicago, Vol. 10, Nbr.2, 2001.

<sup>&</sup>lt;sup>110</sup>Berthon, Hulbert, Pitt (1999), "To Serve or Create? Strategic Orientations towards Customers and Innovation", California Management Review, Vol. 42, No. 1, Fall 1999.

customer driven strategy is based on the assumption that identifying and fulfilling customer wants and needs is the main task that make a company successful. Other companies that define their strategy as "innovation oriented" assume that the key to success is service superiority, which means focus on quality, performance, and value for the services or products offered. The underlying assumption is that changes in technology are capable of changing customer perceptions and expectations. Thus, innovations would create demand. The authors argue that neither focus is right or wrong, yet they are completely distinct. However, the main issue for a company should not be to generically choose one or the other focus as strategic fundament. What is important is to determine what the current focus is, and if this focus is appropriate given the environmental context and overall future business strategy.

## C.3.1.2 Airline Quality and Satisfaction

This section will summarize frequently cited customer satisfaction surveys and explain their methodology. This is important, in order to understand what is actually measured and implied when the public or airlines refer to air traveler satisfaction and quality of air travel. Strategic implications of this analysis include opportunities for new-entrant improvements and focus on key consumer-defined variables. In order to provide real value added, mobile services not only need to improve business processes; it is also crucial that customers perceive these processes as important elements of service satisfaction. Studies conducted independently within the industry are the IATA airport survey, the Airline Quality

Ranking, the Frequent Flyer Magazine/ J.D. Powers survey, and the Zagat Airline survey. In addition, various consulting and research firms conduct service and quality assessment studies. Skytrax is presented in this thesis as an example.

## C.3.1.2.1 IATA Airport Monitor

Airport processes have a substantial stake in the airline value chain. In order to assure overall customer satisfaction, it is important to consider driving forces of satisfaction within airports. The Aviation Information and Research Group of IATA (AIR) conducts annual surveys among international passengers to benchmark service quality at airports around the world. In order to assess customer satisfaction and service quality, IATA developed the Global Airport Monitor including a number of 24 service categories, which range from general (overall satisfaction) to very specific elements (baggage delivery, shopping facilities). The survey distinguishes between departing and arriving international passengers. The most important elements to predict overall customer satisfaction were obtained through regression analysis. These elements are the airport ambience, the ease of making connections, flight information screens, and friendliness/courtesy of airport staff, which was found to be a significant predictor of passenger comfort. While the predictors for customer satisfaction were found to be similar among passenger segments (business and leisure), there were a few main differences. While the option of ground transportation is a significant component of customer satisfaction for business travelers, shopping facilities

was found to be a key element for the leisure segment.<sup>111</sup> Addressing these needs could be a prospective element for enhanced mobile services.

# C.3.1.2.2 Frequent Flyer Magazine/ J.D. Power Survey

Frequent Flyer Magazine and J.D. Power conduct Airline customer satisfaction surveys on an annual basis among readers of Frequent Flyer magazine. While airline rankings in the Air Consumer Report are based on complaints filed with the US. Department of Transportation (DOT), the Domestic Airline Customer Satisfaction Study by J.D. Power focuses exclusively on service perceptions and experiences from US frequent flyers. The 2000 results are based on 6,079 responses from a poll of national frequent travelers, who average a total of 28 flights per year. The table below presents attributes that account for most of customer satisfaction.<sup>112</sup>

<sup>&</sup>lt;sup>111</sup>"Quality Matters: Service Excellence in Airports", Airport World, 2000.

<sup>&</sup>lt;sup>112</sup> J.D. Power & Associates and Frequent Flyer Magazine, 2000.

Seating Area On-Time 11% Performance Aircraft Interior 25% 9% Flight Availability/ Flight Scheduling Attendants 9% 11% Frequent Flyer Food Service Programs Gate Factors 7% Airport Check-7% 10% ln 11%

**FIGURE 4: Factors Driving Overall Satisfaction** 

Source: J.D. Powers & Associates, 2001

The single most important factor in terms of overall customer satisfaction is on-time performance, which has increased in relative importance compared to results obtained in 1999 and 1997. Other important service attributes contributing to satisfaction are check-in and gate factors. While check-in has slightly decreased in importance, gate factors have become more important in 2000 in comparison to prior years. Importance of check-in and gate related service attributes has implications for mobile business strategies since these processes can be integrated into a mobile process chain. Hence, mobile applications are capable of providing value added in this area.

**TABLE 2: Satisfaction Factors over Time** 

(Numbers in percent)

Attribute	Year		
	2000	1999	1997
On-Time Performance	25	26	22
Flight Availability/ Scheduling	9	11	15
Frequent Flyer Programs	7	6	4
Gate Factors	10	8	9
Airport Check-In	11	15	15
Food Service	7	7	5
Flight Attendants	11	11	6
Aircraft Interior	9	7	7
Seating Area	11	10	12
Post Flight Services	N/A	N/A	5

Source: J.D. Powers & Associates (1997, 1999, 2000)<sup>113</sup>

The 2000 survey on air travel trends, patterns and perceptions developed by Frequent Flyer Magazine reveals a trend towards online bookings, which have increased from 4 percent in 1998 to 13 percent in 2000. Also the number of people visiting an airline's web site has increased from 58 percent to 69 percent for the same years. Although travel agents are still the preferred choice for booking a flight, the number of respondents marking this as their preferred method (57 percent in 2000) has been declining drastically by 18 percent since 1998. Preference of direct bookings with an airline has slightly increasing in popularity by 2 percent over the year to 19 percent in 2000. Despite airlines claiming to have emphasized on improving customer service, the survey shows that only 35 percent of respondents indicated to have noticed such improvement with respect to flight information and courtesy of flight and gate attendants.

<sup>&</sup>lt;sup>113</sup> Note: Figures for 1998 are not included in the chart/table since they were not available showing the same categories.

In terms of using wireless devices during travel, 41 percent of respondents indicated to use handheld devices to access airline and travel sites through the Internet, and to perform tasks such as placing or changing reservations.<sup>114</sup>

## C.3.1.2.3 Airline Quality Rating

Another frequently cited industry survey is the Airline Quality Rating. Since its initiation in 1991 by two professors of University of Nebraska and Wichita State University, the airline quality rating has established annual rankings of US domestic airlines. The objective of the rating is to develop an instrument to monitor quality over time while allowing comparing quality scores between airlines and over time. The underlying rationale of the rating is to base the score on publicly available performance measures rather than data derived from customer surveys. Input factors are extracted from the Air Travel Consumer Report, the hincludes performance data airlines are required to file with the US Department of Transportation (DOT) on a monthly basis. The AQR scores are the weighted average derived from a number of 14 input factors that are assumed crucial for air travel consumers. The factors included are on-time performance, overbooking, mishandled baggage, and customer complaints

<sup>&</sup>lt;sup>114</sup> Frequent Flyer Magazine Survey, 2000.

The Airline Quality Rating 2000 was developed by Professor Brent D. Bowen of University of Nebraska at Omaha (www.unomaha.edu) and Professor Dean E. Healy of Wichita State University. It is sponsored by both universities.

<sup>116</sup> U.S. Department of Transportation's monthly publication.

divided into 11 subcategories.<sup>117</sup> The weights for each input were determined through an opinion survey among airline industry "experts" rating input factors by the importance assumed for airline travelers on a scale from zero to ten<sup>118</sup>. Similar to the J.D. Power survey described above, the ARQ also attributes the highest weight to on-time performance. Yet, the relative importance is far less pronounced in the Airline Quality Rating.

**Table 3: AQR Factors and Weights** 

INPUT FACTOR	WEIGHT (ω;)
On-Time Performance (OT)	8.63
Denied Boarding (DB)	8.03
Mishandled Baggage (MB)	7.92
Customer Complaints (CC)	7.17

Source: AQR 2000

$$AQR = \frac{8.63OT - 8.03DB - 7.92MB + 7.17CC}{\sum_{i} \omega_{i}}$$

According to the Brent and Bowen (2000), the service level of the U.S.

Airline industry has been declining in the 2000 survey, showing a trend that could be observed over the last 3 years. The airlines' service attitude is described as anti-consumer oriented yielding an increased level of passenger dissatisfaction in an air transport system that has reached its limits. Yet, these conclusions have

<sup>&</sup>lt;sup>117</sup> Customer Complaints consists of Flight Problems (8.05); Oversales, Reservation, Ticketing, and Boarding (7.08); Fares (7.6); Refunds (7.32); Baggage; Customer Service (7.2); Disability; Advertising (6.82); Tours; Other (7.34).

Rhodes, Waguespack (2001)."Airline Quality: Present Challenges, Future Strategies. Handbook of Airline Strategy".pp.469-477.

been questioned by the Air Transport Association and criticized by United Airlines. The main critique points are that the study does not properly reflect the reality of US air travelers and misleads consumers. In response to the report, airlines have pledged to create a task force consisting of industry and government affiliates in order to improve the flow of information regarding delays and flight cancellations.

It is critical to observe that this has a direct relationship to the expected benefits of an m-business model.

## C.3.1.2.4 Zagat Airline Survey

Another survey cited by Airlines is the Zagat Airline Survey. <sup>120</sup> Zagat is renowned for its consumer survey-based dining, lodging, and leisure guides. The company also publishes annual surveys covering hotels, resorts, spas, nightclubs, and other entertainment and shopping resources. The 2001 Zagat Airline Survey is based on input from 31,500 frequent flyers who were asked to rank 70 domestic and international airlines in the categories of comfort, service and food. In order to evaluate attributes, the survey uses a 30-point scale, which Zagat also uses for the ranking of restaurant surveys. One of the main distinctions made in this airline survey is that it evaluates first, business, and economy class separately. One of the surprising results of the survey was that

<sup>&</sup>lt;sup>119</sup>"Service Quality Report Quantifies Travelers' Frustration with Airlines Passenger Turbulence", Omaha World-Herald, Omaha, Apr. 6th, 2001, 17-18.

<sup>120</sup> Jet Blue Airways, for example, cites survey ratings on its web site (www.jetblue.com).

Jet Blue Airways scored second in the category of seat comfort, despite the fact that the company's seat pitch is actually inferior to the pitch of its competitors.

While it can be argued that out of the three areas of measurement only the service element can be directly tackled by a mobile business model, it still confirms the need to focus on features that customers value most.

## C.3.1.2.5 Skytrax

Skytrax is a business research firm specialized in performing airline surveys on a worldwide basis since 1990. The objective of the survey is to provide airlines with a professional analysis of front-line standards with regards to the delivery of product and service in an airport, as well as in the onboard environment. In order to evaluate service standards and quality offered, Skytrax conducts detailed audits and in-depth interviews with air travelers rather than conducting surveys as passenger polls. <sup>121</sup> Airline Survey reports contain a qualitative analysis for each airline by ranking performance separately by service delivery functions for each key area. The main areas include Check-In, Airport Lounges, Catering, On-Board service, Cabin staff, comfort, and entertainment. Yet, also less tangible aspects such as perceptions of corporate brands and image are included. <sup>122</sup> Especially check in features (efficiency, service delivery, and consistency), as well boarding, departure, transfer, and arrival services

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<sup>121</sup> www.airlinequality.com/SurveysSurvey.htm.

<sup>&</sup>lt;sup>122</sup>List of features consists of: Check-In (facilities, efficiency, service delivery, consistency); Airport Lounges (product, service); Boarding and departure service; Arrival and transfer service; Corporate branding in the airport; Cabin seats; Reading materials; Airline Magazine; Comfort/Amenities; Catering (presentation, food quality, ancillaries, entrees, consistency, quantity/portions); Amenity kits; In-flight entertainment; Cabin staff (meal services, friendliness, style and finesse, service quality, service intensity, consistency); First/Business priority; Corporate Brand and Image.

present potential targets in terms of a mobile service strategy (please see a detailed list of features provided in the footnote).

#### C.3.2 AIRLINES

## C.3.2.1 Mobile Strategy and Applications

Information technology is the single largest capital expense for US companies. With respect to overall cost, only labor exceeds IT expenses. 123

The US airline industry has been the leader in IT spending over several in terms of volume. Yet, the majority of US airlines predict no increase in IT spending for 2001 or 2002. This is in contrast to the broader worldwide industry. Over 50 percent of airlines have increased their IT budgets and predict further increases for the coming year. The average IT spending has increased from 2.4 percent in 1999 to 2.8 percent in 2001. Especially Asian carriers are planning increased investments in their IT infrastructure.

As the main obstacles for achieving a successful IT strategy, airlines reported lack of skilled IT personnel, lack of investment, and lack of board-level support and vision. The trends described in this paragraph relate to figures published before the September 11 events. Drastic cuts in IT spending are likely due to the financial situation of US airlines. IT budgets typically range between 2-5 percent of revenues. The prevailing tendency among upper airline executives

<sup>123 &</sup>quot;How to Succeed in IT", CFO Magazine, July 01, 1997.

appears to view IT mainly as a cost center rather than as driver creating value for the firm.

The role of IT in airline processes, however, may be highly underestimated. Given the extensive dependence on information technology in key business areas such as distribution and maintenance, IATA estimates that actual airline spending on IT is closer to 10-15 percent of sales. The important role IT plays in an airline environment can also be demonstrated in financial figures. Spin-offs and IPOs of airline IT engagements, such as Amadeus and Galileo, have generated more shareholder value than the combined airline industry in the past 50 years. This argument supports the possibility that airline managers often underestimate the importance of IT<sup>124</sup>.

A recent survey conducted by Airline Business and SITA<sup>125</sup> found a trend in the airline industry to shift the strategic focus on information systems towards the use of open systems and the use of the Internet protocol (IP). When asked about the main strategic goal driving the IP focus, most responding airlines expressed the objective to gain a competitive advantage. The second most frequent response was the potential for cost reduction. In order to evolve towards the Internet protocol, airlines become increasingly aware of mobile communications. About 29 percent of airlines worldwide have introduced mobile applications based on the wireless application protocol (WAP). The following graphic shows when worldwide airlines anticipate introducing WAP for customers.

1,

<sup>&</sup>lt;sup>124</sup> Clarke (2001), "Cutting IT can seriously damage your worth", Airlines International, November-December 2001, 60-61.

<sup>&</sup>lt;sup>125</sup> Société International de Télécommunications Aéronautiques (SITA).

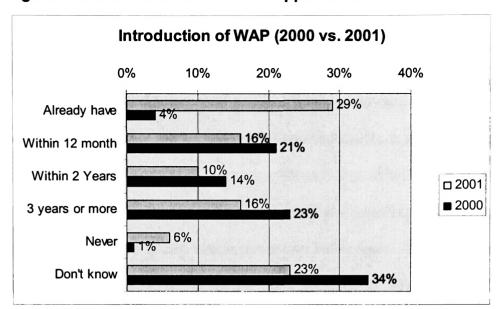


Figure 5: Introduction of B2C WAP Applications

Source: 2000/2001 Airline Business and SITA "IT Airline Survey"

The mobile trend in the US is much more pronounced. Almost all major carriers have introduced mobile applications of some type. From a technological point of view, mobile technologies offer far more advanced applications than the ones currently in use. According to SITA director general John Watson, the main limiting factor is the lack of common standards and deficiencies associated with the wireless protocol (WAP). Therefore, current mobile applications appear to be experimental rather than providing real value added. Other opinions expressed by industry analysts state that the reason for the quick adoption of wireless technologies in the airline industry can be attributed to the fact that they create immediate benefits, typically generating return on investment (ROI) within an year. Current applications may not appear very innovative and only address the most obvious needs. Yet, they are still innovations because they provide services

that could not be offered before.<sup>126</sup> The variety of mobile applications in the future may increase substantially as mobile technology is expected to be the largest scale new technology for the airline industry within the next 3 to 5 years.<sup>127</sup>

The deployment of an IT and e-commerce strategy has some flaws with respect to managing the technology. E-commerce plays a vital role in airline processes, yet it remains rather vague on who should be responsible for the development of e-commerce solutions within the organization. Also unclear is the role of IT for airline e-commerce. American Airlines and America West organize the e-commerce function under the Chief Information Officer (CIO). Continental, Delta, US Airways, and Northwest have allocated e-commerce responsibilities to the marketing department, while United sees e-commerce as responsibility of the finance department. Especially if one regards mobile business as a mobile version of e-commerce, it becomes apparent that such diverging philosophies will also impact future strategies for mobile applications.

#### C.3.2.1.1 American Airlines

American Airlines offers customers the option to register for proactive flight status notification for Palm OS devices, cell phones and pagers. Also, information regarding baggage claims is available. Access to mileage award accounts and flight information including schedules and gate information is available on mobile PDAs. An additional wireless feature available on PDAs is the receipt of sales promotions branded as saleAAlert. Furthermore, American

<sup>128</sup> Bell (2001), "Empowering IT leaders", Airline Business, October 2001, 95.

<sup>&</sup>lt;sup>126</sup> Raddan (2001), "Leading the way to Wireless", Computer world, September 24, 2001.

<sup>127</sup> IT Survey Trends 2001, Airline Business, August 2001, 50-58.

Airlines offers broadband Internet access via a local area network in various

Admiral Club lounges and through a vendor at gates. In the future, AA plans to
provide high-speed Internet access in aircraft cabins. 129

Currently, the main focus of American's mobile applications appears to be on the supply side. Mobile PDAs are used to check in passengers (Roving Agents) and to scan cargo in order to improve tracking and to reduce the number of mishandled items. These wireless scanning devices are used to transmit data to the company LAN where a radio frequency (RF) network is unavailable.

In October 2001, American Airlines has introduced wireless PDAs connected to a wide area network (WAN) to improve its business processes for tracking and shipment of cargo. The aim is to reduce the number of misdirected or lost shipments and increasing efficiency of routing between hubs. The wireless application is based on Sabre's travel management system.<sup>130</sup>

#### C.3.2.1.2 Alaska Airlines

Alaska Airlines markets its set of mobile applications as "alaskaair.com anywhere". Currently, the airline offers wireless access to mileage accounts, schedules and flight status. All services are available on PDAs operating under Palm OS and cell phones. Alaska was the first airline to adopt a wireless checkin and boarding solution, which was discontinued after September 11<sup>th</sup>. Yet, the airline announced its comeback after considering security related aspects.<sup>131</sup>

<sup>&</sup>lt;sup>129</sup> "Wireless Internet Access at airports set to Take Off", Airwise News, September 19, 2001.

<sup>&</sup>lt;sup>130</sup> "Plane Truths: American Goes Wireless", June 2001.

<sup>&</sup>lt;sup>131</sup> Wireless NewsFactor, Oct. 21, 2001.

## C.3.2.1.3 American Trans Air (ATA)

American Trans Air (ATA) brands its mobile applications under the "Straight to the Gate" logo. Under this service brand, it was one of the first airlines to implement Sabre's WAP based mobile check-in and boarding application. This service, however, was discontinued after the September 11<sup>th</sup> attacks and the company has not announced plans to reinstall this feature. ATA's current mobile applications include information on flight status and access to schedules. In addition, ATA offers weather information and an application to search airport codes. All of ATA's mobile applications are available for PDAs equipped with the Palm operating system, for cell phone, and pagers.

Another mobile solution part of the "Straight to the gate" service line is the "Airport Express Agent". Customer agents equipped with a wireless PDA can access flight information, modify existing reservations, assign or change seats, print boarding passes, and check-in passengers with carry-on luggage.

### C.3.2.1.4 Continental Airlines

Continental's wireless services include access to flight schedules, mileage accounts, itineraries, and flight paging. Customers can also check for seat availability and receive information on ticket office locations and company contacts. All of these mobile applications are available for Palm OS and mobile phones. Flight paging is also available on pagers.

#### C.3.2.1.5 **Delta Airlines**

The focus of Delta Airline's IT strategy reflects a trend towards the use of standard Internet protocols and systems integration. The main objective is to assure that information can be effectively shared among different sub systems. Hence, IT projects concentrate on interconnecting all elements of customer operating systems. Thus, a change made by operations control such as flight cancellations or flight delay, would be communicated throughout all customer and operating systems. 132

In order to manage the ambiguity between the need to control costs on one hand, and the necessity to increase IT efficiency on the other, Delta Airlines stresses the importance of economic value for the implementation of its IT projects comprising of e-commerce as well as mobile initiatives. In order to estimate return on investment (ROI), Delta valuates its projects based on net present value, strategic value, as well as risk associated with each project. Strategic value is measured in terms of customer service. The total value of an initiative is determined by a weighted average of NPV and strategic value. In a second step, this value score is then plotted against associated risk. The risk measure contains the sum of the initial investment, implementation costs, and technological hurdles. 133 For the ROI assessment of its wireless projects, the company measures productivity gains and cost savings, although availability of reliable data is scarce.

Air Transport World, Oct. 2001, 36.
 "Had to Measure", eCFO Magazine, No. 12, Fall 2001, Vol. 17, 28-36.

Despite the lack of well-founded data. Delta airlines assumes mobility of information and travel data to be a highly desired asset and an important driver of customer satisfaction among their business customers. 134

In addition to factors relating to productivity and cost reduction, mobile strategies may also bring more immediate financial results. Delta Airlines estimates that providing wireless access to its web site through PDAs has had a positive impact on the number of e-tickets it sold online. E-ticket sales accounted for 5 percent of Delta's total ticket sales in 2000. 135

Using a mobile phone or a Palm OS equipped PDA, Delta Airlines offers wireless access to itineraries, as well as flight status and schedule information. Contact information is available for PDAs only. After having successfully completed a test phase of a "virtual check in" application in seven east coast markets, Delta decided in August 2001 to introduce wireless check-in on its domestic network. The wireless check-in allows travelers with carry-on to checkin remotely within 4 hours to 30 minutes before scheduled departure. 136 The virtual check-in product is available for SkyMiles members using a WAP cell phone, a wireless PDA, through the company web site, or simply by calling a toll free number. After a passenger has checked in using the virtual check-in product. a bar code is sent to his Medallion membership card. 137 With this card. passengers are able to proceed to the gate, where a gate reader prints out a seat

<sup>134 &</sup>quot;How to Measure", eCFO magazine, April 2001.

<sup>&</sup>lt;sup>135</sup> American Airlines Enlists Wireless for Schedule Changes, Wireless NewsFactor, February 2001

<sup>&</sup>lt;sup>136</sup> Source: Wireless Airport Association/ AAAE

<sup>137</sup> Loyalty card available for frequent flyers who are eligible for an elite status in Delta's Loyalty program

number after showing proper identification with a photo ID. 138 The virtual check-in product is aimed to position Delta as a leader in customer satisfaction. One of the reasons why Delta has not pushed its automated check-in kiosks is that the option of mobile check-in was viewed more promising. If the current virtual check-in product is accepted well among travelers. Delta plans to make this service available to all of its frequent flyer members. 139

Delta is currently investigating features to be added to the line of wireless services. Potential features include an application allowing passengers to select and change seat assignments, to reserve and pay for tickets, as well as to request standby and upgrade status. 140 Additionally, Delta plans to enhance its existing notification service, which would notify passengers in case their luggage did not get on the flight, so that passengers do not have to wait unnecessarily at the baggage claim. 141 Also wireless onboard services are considered.

#### C.3.2.1.6 **Frontier**

Frontier is the only low-cost airline having implemented wireless flight information services. It offers flight notification and schedule information on PDAs, mobile phones, and alphanumeric pagers.

<sup>&</sup>lt;sup>138</sup> "We are not waiting for a turnaround", Air Transport World, October 2001, 29-36.

<sup>&</sup>quot;We are not waiting for a turnaround" Air Transport World, Oct 2001, 36.

<sup>&</sup>lt;sup>140</sup> "Mad to Measure", eCFO.

<sup>&</sup>lt;sup>141</sup> Airlines International, September-October 2001, 30.

#### C.3.2.1.7 Jet Blue

Jet Blue has introduced limited wireless curbside check-in and implemented roving agents. The most recent IT move was to deploy self-service kiosks. The company has discussed the introduction of mobile applications for the passenger side including a wireless check-in system. However, Jet Blue's main customer group are leisure travelers and the airline is not convinced that mobile applications will create the necessary benefits to justify risk and cost associated with the implementation of wireless services. Thus, the airline is not planning to launch a mobile strategy within the next two years.<sup>142</sup>

Nevertheless, on the supply side Jet Blue Airways has adopted Sabre's Roving Agent solution allowing customer service agents to check in passengers via a handheld device and access passenger and flight information connecting to the airline reservation system through a local area network. This service is currently only available in Jet Blue's terminal 6 at JFK airport.

#### C.3.2.1.8 Northwest

Northwest's mobile strategy emphasizes three primary objectives. To simplify travel processes, to make these processes more predictable, and to offer passengers service choices. The need to offer choices is based on the assumption that customer service expectations differ significantly. While some travelers would be happy to find their own way around the airport and to manage all processes themselves using a wireless device, there are also "technology adverse" travelers who prefer waiting lines to self-service technology. A third

<sup>&</sup>lt;sup>142</sup> Jet Blue Colloquium, Embry-Riddle Aeronautical University, October 2001.

group is identified as "high touch" customers willing to accept a certain degree of inconvenience in order to receive full service in return. Attempts to simplify travel processes aim at flight and cancellation notification. This service is available to all customers upon sign up through the company web site.

The airline reported that cost savings play an important role in its wireless strategy. The list of Northwest's IT projects include Internet Check-in and portable agent workstations. By using these workstations, agents can issue tickets and boarding passes, which attempts to reduce waiting lines. The airline first introduced such mobile workstation (PAWS) in 1999 for service recovery in case of irregular operations. 143 After seeing that this service has caught on with customers, the mobile solution is now broadly used whenever temporary congestion problems arise.

Northwest's mobile features are flight and cancellation notification. This service is available to all customers upon sign up through the company web site. In addition, customers can access mileage accounts, inquire availability for upgrades, view and change reservations, book flights and change existing reservations. Northwest also offers wireless check-in 144 branded as "elite checkin". This application is based on a proximity smart card, which automatically requests the print of a boarding pass as a passenger equipped with such card approaches a check-in facility. 145 After increased security procedures in response to September 11th events have slowed down the check-in process, Northwest

<sup>&</sup>lt;sup>143</sup> Northwest Offers Choices for Simplification", Airlines International, September-October 2001, 46.

<sup>144 &</sup>quot;Northwest Offers Coices for Simplification", Airlines International, September-October 2001, 45.

<sup>&</sup>lt;sup>145</sup> Airwise/Northwest, Feb. 2000

reported to have decreased minimum check-in time from 120 to 90 minutes through the use of improved check-in technology and the reintroduction of curbside check-in at most locations. Another area where Northwest is currently studying wireless applications is the implementation of a wireless curbside check-in.

#### **C.3.2.1.9** Southwest

Southwest Airlines has not showed much interest in mobile applications although the airline is perceived as leader in e-commerce. Total sales through its web site accounted for revenues of about \$ 1 billion. Unlike the majority of Southwest's competitors, the airline does not see potential benefits in mobile applications commonly available to air travelers. According to Southwest, the high level of flight frequencies make personalization and notification services needless. Yet, partnering with BAE Systems, Southwest is planning to introduce smart cards within the next few months, which would serve as reusable boarding passes. At the check-in counter, passenger name records (PNR), flight related information, as well as biometric data, could be transmitted to a RF chip in the boarding pass.

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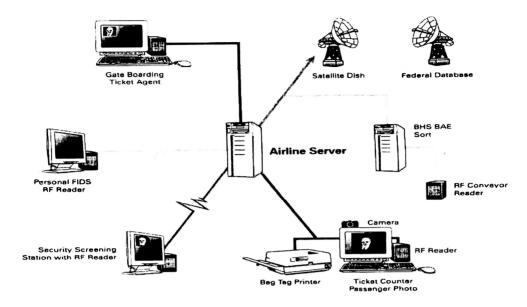
<sup>&</sup>lt;sup>146</sup> "Northwest cuts back check-in time", Airwise News, November 6, 2001.

<sup>&</sup>lt;sup>147</sup> "Northwest Plans for Wireless Curbside Check-in", Network Computing, March 3, 2001.

<sup>&</sup>lt;sup>148</sup> "Top 50 companies", Smart Business Magazine, Sept 2001, 84

<sup>&</sup>lt;sup>149</sup> BAE Systems, Passenger Terminal Expo, Orlando, October 2001.

Figure 6: BAE Systems RF Check-in Model



Source: BAE Systems, Passenger Terminal Expo 2001, Orlando

#### C.3.2.1.10 United Airlines

According to United, focus group interviews have shown that value added features based on wireless technology help to persuade customers of product superiority. Frequent travelers whish to be in control of their flight schedules and appreciate timely information. Especially successful has been the "alert service". Its usage has increased by 2,800 percent in 2000. In the beginning of 2001, United reported a drastic increase in the use of its wireless notification service, measured in the number of customers signing up for the service and requests sent. Since its introduction in January 2000, the number of paging request has totaled 235,000.

**United's Paging Requests** 400,000 350,000 345,000 300,000 250,000 235,000 200,000 200,000 150,000 100,000 50,000

Jan-01

Figure 7: Increase in United's Paging Requests<sup>150</sup>

Source: United Networks

Dec-99

**3.400** 

Jun-00

The primary objective driving United's wireless strategy is customer satisfaction. Wireless services are viewed as a tool to build customer loyalty and retention. They can also help to establish a distinct competitive advantage. More than half of United's customers who signed up for the notification service are frequent fliers, and more than half of them exceed 100,000 miles per year in the air. Most requests are made from customers in the San Francisco area, followed by Los Angeles and Chicago. 151

Jul-01

Feb-02

Having the ultimate goal in mind to enable passengers to bypass check in desks, United has also been looking into the possibility to offer wireless check-in. The model would be based on a WAP application. In contrast to the first wireless Check-in solutions that were in place by Alaska Airlines and ATA in the beginning of 2001, United's mobile process chain should eliminate the need for printed confirmation. 152

150 Source: United Networks Press Releases

<sup>&</sup>lt;sup>151</sup> Airline Paging Flying High, Wireless Week, Feb 2001, 14

<sup>152</sup> Airline Paging

United's mobile strategy appears to be less focused on ROI. Innovation cost for wireless applications was not a main factor for the rollout of its wireless strategy. Since wireless applications are based on information captured by existing systems, innovation costs were perceived to be controllable.

Consequently, United assumed that the risk associated with the emerging mobile technology could be reduced to a residual. The carrier expects benefits associated with the offering of mobile services to outweigh costs.<sup>153</sup>

The Airline's line of wireless services, branded as "EasyAccess", includes the access to itineraries, mileage accounts and flight status information. Further applications allow customers to receive contact information and to check for seat availability, including upgrades and award travel. United's most current feature added to the line of wireless services is the enhancement of its travel alert service, which has been available since 1999. The service allows customers to register for the service via United's web site. Passengers can then receive customized travel alerts via a wireless device of choice, as well via e-mail and automated telephone message. Information includes flight delays, cancellations, seat upgrades and other context specific information. Also included in the service will be notifications on re-bookings, which would proceed automatically in case of significant delay or flight cancellation<sup>154</sup>. Besides the provision of information, United's mobile features also let travelers pursue bookings via a handheld mobile device. United claims to be the first US airline offering wireless bookings and

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<sup>153</sup> Leading the way to Wireless, Computer World, Sept 24 2001)154"United Airlines Partners with Centerpost", Business Wire, Aug 6., 2001.

flight information via PDAs.<sup>155</sup> Partnering with Boeing, American Airlines, and Delta, wireless in-flight service were planned for the near-term future. Given recent financial difficulties, however, this plan has been postponed.

The following table summarizes the current mobile applications described above.

<sup>&</sup>lt;sup>155</sup> "United Introduces WAP Booking and Ticketing", Airwise News, November 2000.

**TABLE 4: Mobile Application Overview** 

			Alaska	AA	ATA	Am. West	Delta	СО	Front	Jet Blue	NWA	UAL
		Flight Status/Paging	X	X	X	X	X	X	X		X	X
		Flight Schedules	X		X	X	X	X			X	X
	fed	Mileage Account Info	X	X	F (45.1)	X		X	<b>基础 的</b> 数	10.5	X	X
	rela	View Itineraries					X	X			X	X
Z	Flight related	Contact Information				X	X	X			X	X
INFORMATION	₩.	Baggage Claim Info		X							c.net-recruite-co	
₹ S		Seat Availability						X			X	X
FO		Award Av./ Upgr. Status									X	X
<b>=</b>		Sales Promotions		X			065)	204		* 4	X	
	जु	Weather Info			X							
	General	Airport Codes			X						77.75	Tail
	Q	Airport Maps						Litter and Mariane			X	
		Web access		X			X	X			X	X
		Wireless Check-In	X <sup>1</sup>	S. B. C. B. C.	X <sup>2</sup>		X			P. P	X	2000
က္ခ		Roving Agent	i ili desdi	X	X	10000	kaj ili	Juan.	400	X	VW.	
CES		Wireless curb side C/I	ni. Simbilia atti ili si ili wisi ni ka	SECTION TO COMPANY	T. Carlon Control	tion and the control of the			and the second	X		
PROCESS		Book Flights							A 140		X	X
Δ.		Ticketing								le sette e	X	X
		Reservations (change)									X	

(1): reinstated; (2): service canceled after 9/11 without further notice

# C.3.2.2 Strategic Positioning

# C.3.2.2.1 Strategy

In order to conclude which strategy US airlines pursue with respect to their mobile initiatives, or if they have a strategy at all, three different perspectives of

strategy should be distinguished: The planning and positioning approach, the design school, and the game theory perspective.

From a positioning point of view, strategy becomes a means of locating an organization in the business environment. Thus, strategy functions as a mediating force between a company and its environment. In order to aspire a certain position, a company develops a strategic plan, which is the result of an established vision, a mission, and clearly defines objectives<sup>156</sup>. The positioning point of view is also the underlying view of the environmental scanning presented in this thesis. In terms of strategic positioning, Porter (1985) describes three generic strategies for companies to position themselves in order to sustain a competitive advantage. These strategies are cost leadership, differentiation, and focus (core market vs. niche).

Another point of view is to regard strategy from the designing perspective. The premise of the design school is that strategy is a process over time evolving in increments. It is seen as a pattern in a stream of actions rather than the result of an abstract planning process<sup>157</sup>. Thus, strategy is consistency in behavior regardless whether intended or not. Mintzberg (1995) identifies three different categories of strategy, a deliberate strategy, an unrealized strategy, and an emergent strategy. A deliberate strategy is one that is intended and also realized, while an unrealized strategy is one that was also intended but not realized. The third category, the emergent strategy, is characterized by being realized without having been intended.

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<sup>&</sup>lt;sup>156</sup> Thomson, Strickland, "Crafting and Executing Strategy", 17.

<sup>&</sup>lt;sup>157</sup> R. Bresser, Strategische Managementtheorie, DeGruyter, 18-38.

The game theory approach towards strategy takes a rather reactive approach. Strategy is interpreted as the planning of sequences of moves and actions of a rational actor, who possesses a certain utility function 158 seeking to maximize utility as a function of the anticipated or observed move of the rival player. Mobile strategies of US airlines could be interpreted as sequence of non-cooperative games, which are games consisting of two players versus a cooperative game, where N players act simultaneously. Models in game theory are based on certain equilibrium such as the "Nash-equilibrium", which describes an optimal situation where no player has an incentive to choose a different strategy given the response of the rival player to obtain the best possible result. 159

## C.3.2.2.2 Positioning

Most airlines claim that the driver behind their mobile initiatives is to offer customers choices<sup>160</sup> and to improve customer convenience. This appears to be a differentiation strategy. On the other hand, however, they claim to focus on the cost saving potential of mobile business. According to Porter, this will not lead to a successful strategy as companies have to make a choice whether to compete on cost or differentiation in order to yield above average performance.<sup>161</sup> Also scope, the third element of strategic positioning in terms of Porter's generic

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<sup>158</sup> Neumann and Morgenstern developed the concept of utility functions in 1944.

<sup>159</sup> A. Dixit, B. Nalebuff, "Thinking Strategically", Norton, New York: 1991, 74-80.

<sup>160</sup> For example Northwest

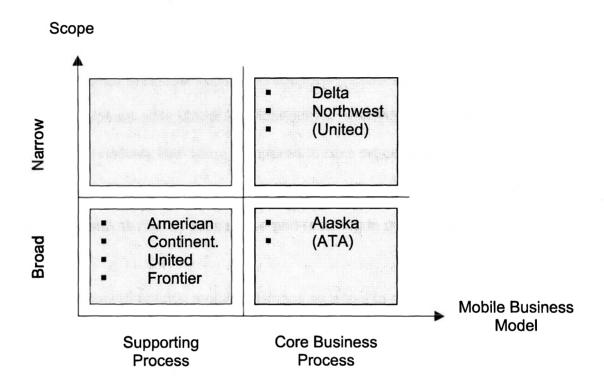
<sup>&</sup>lt;sup>161</sup> H. Minzberg, The Strategy Process, 87 (describing Porter's generic strategies).

strategies, remains undefined in the current mobile strategies revealed by US airlines. Most airlines offer their applications to all customers regardless of the segment. Only Delta's virtual check-in and Northwest's smart card check-in are made available exclusively to prime customers. However, the assumption that the remaining carriers target the core market rather than a niche cannot be sustained. The mere fact that customers require a mobile device in order to make use of wireless services leads to the self-segmentation of potential users. United, for example, offers the possibility to purchase tickets using a PDA. Yet, only 2 percent of travelers possess a PDA that is equipped with a wireless modem necessary to perform the purchasing process. Although all mobile business initiatives segment the customer base by availability of necessary devices, the market segment targeted by Delta's and Northwest's check-in applications is significantly more narrow and sharply defined. United's value added services (information etc.) are available to all customers. The only core process oriented application offered is the possibility to purchase tickets using a wireless PDA. Since the targeted customer group seems to be narrow, United is grouped with Northwest and Delta for its ticketing application, and in the broad sector for its remaining applications.

The main dimensions that distinguish wireless portfolios of US airlines are thus scope, and the focus of the mobile business model. Focus can be distinguished by targeting only supporting business processes or also airlines core airline processes. The author of this thesis defines core processes as activities that are crucial to perform in order to fulfill the basic need of transportation, getting from point A to point B. The list of such activities includes

ticketing, check-in, and boarding. In contrast to core processes, supporting processes are defined as activities providing value added, yet not being immediately essential for fulfilling basic needs of transportation.

Figure 8: Positioning through m-business on the passenger side 162



Most airlines employ m-business to provide value added services in the category of supporting processes, making these services available to all customers (broad scope) who possess an adequate mobile device. In addition to providing information, Delta, Northwest, Alaska, American Trans Air<sup>163</sup>, and to a certain extend United, reveal a focus on core business processes in their m-

 $<sup>^{162}</sup>$  As suggested by the author of this thesis  $^{163}$  Pre 9/11

business models. An interesting focus differentiation can be noted with respect to the target group of wireless services. Alaska and ATA clearly intend to serve a broad customer base, while Delta is an example for making their service only available to an elite and sharply distinguished customer segment.

It appears to be the case that airlines focusing on narrow scope have selected smart cards/ loyalty cards as mobile devices. In contrast, carriers catering to all segments focus on WAP applications.

The fact that the sector of narrow scope and supporting processes (upper left corner) is empty appears quite plausible. Mobilizing supporting processes is likely to contribute relatively little value compared to core processes, as these are more important in order to fulfill basic needs. Thus, contributing little value to few customers simply makes no business sense and resulting in a low return on investment (ROI).

US airlines do not employ mobile business as a tool to position themselves according to Porter's generic strategies. However, mobile service portfolios can be differentiated in terms of scope and the focus of the mobile business model. Although airlines position themselves differently according to these dimensions, it is questionable whether this positioning is of strategic nature. The choice of some airlines to target primarily elite travelers with mbusiness may make sense considering availability of mobile devices. Yet, the main value contributed by mobile technology might be found in the broad market. Differentiation moves in high yield segments can be easily justified by the high profit margins. In a move to decrease waiting time for premium customers, for example, most major US airlines have established separate security lines during

peak hours. Such initiatives, however, are impossible in segments where yields are close to unit costs, or even below. This supports the argument that airlines are likely to reposition themselves in the future towards a broad scope, considering the positioning categories as described above.

Referring to the different views of strategy described, it can be concluded that US airlines do not follow a mobile strategy from a planning and positioning point of view. Yet mobile initiatives could be explained as "emergent" strategies, which result from a pattern of trials based on availability of technology and general (non quantitative) assumptions how mobile technology can improve customer satisfaction. Also an understanding of mobile strategy from a game theory perspective can help to describe mobile initiatives. In this case, airlines would introduce m-business applications in expectation that competitors will do so. Assuming the existence of a Nash Equilibrium, Delta Airline's move to offer its virtual check-in product, for example, would maximize its expected utility given Southwest's decision not to introduce such services. In return, Southwest would maximize its utility by not adopting mobile services given Delta's decision to do so, since this would destroy Southwest's attempts to "do things differently".

# C.3.2.3 M-Business in the Airline Value Chain 164

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<sup>&</sup>lt;sup>164</sup> Hunger/Wheelen, Strategic Management, 6<sup>th</sup> edition, New York, 1998, 118;
Steinmann/Schreyoegg, Management, 203

The areas where traditional airline processes are potentially transformed into a mobile business model are reservations, ticket sales, check-in and boarding, airport lounges, and baggage services.

Air service and network, as well as on-board services are currently not addressed by m-business initiatives. 165 This however, does not automatically imply that there are no mobile opportunities in this area. This becomes clearer when extending the analysis of the value chain to the broader model of a supply chain. The supply of food being part of onboard services, for example is a function of catering. Modifications of traditional catering processes are currently emerging in form of e-commerce (or to be consistent, e-business<sup>166</sup>). Lufthansa's Sky Chefs offers an e-commerce based catering solution branded "eSky Chef", and formerly Swissair owned Gate Gourmet developed a solution named "e-gate matrix". Once e-business processes are broadly introduced in all segments of the airline value chain, it is only a small step from a technological point of view to reconfigure these processes into a mobile business model. The point to be made is that mobile business will find its place in all areas of an airline's activities running through the entire value chain. Mobile business is likely to substitute, or at least support all e-business activities, yet not all areas are addressed at the same pace.

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<sup>&</sup>lt;sup>165</sup> Note: WLANs within aircraft cabins are not included in this discussion, as their impact on adding value to customers at this point are too indirect.

PriceWaterHouse Coopers describes the difference between e-commerce and e-business similar the argumentation presented to distinguish between m-commerce and m-business, see section "What is mobile business".

The following graphic shows where mobile processes can be presently found in the value chain of an airline.<sup>167</sup>

Figure 9: M-Business in the airline value chain

			Carried South State		
- Check seat availability- - Request upgrades - Purchase ticket - Receive wireless ticket	- Mobile check-in - Mobile boarding - Gate/ delay information	- Internet access through wireless LANs	N/A (but possible)	N/A (but possible)	- Wireless baggage scanning - Wireless baggage info

# C.3.2.3.1 Impact on Airline Business Model

The shift towards mobile business has an impact on they way an airline conducts business. One of the immediate consequences of substituting traditional processes by mobile business activities is the loss of touch points with customers. This begins with the simple case of receiving flight information on a wireless device instead of interacting with an agent by calling the 1-800 number, checking-in and boarding a flight, and in the near future being able to file baggage irregularity reports through a WAP application for lost or damage baggage. The only immediate touch point an airline retains with its customers is through flight attendants. But even for in-flight service it would be possible to

<sup>&</sup>lt;sup>167</sup> Value chain is based in Porter, "Competitive Advantage", 1998, 150.

implement mobile processes such as ordering a meal or drink through a wireless device<sup>168</sup> (whether this makes sense from a business point of view is another question). However, the increasingly virtual character of an airline is not only attributed to mobile business. The loss of touch points was initiated by ebusiness activities such as purchasing of tickets through an airline's web site, and was extended by the introduction of self-service check-in kiosks, e-ticketing, and e-check-in. The unique impact of mobile business for the trend towards a virtual organization resides in the ubiquity aspect. All prior e-commerce based applications were limited to a specific location (check-in kiosk) or by the availability of Internet access (home, office). The Internet becomes "mobile" as telecommunication networks evolve into the third generation (3G), devices are able to display html content, and markup languages become more efficient. For the business model of an airline this implies that customer touch points will not only get lost through substitution of e-business activities performed regardless of location. In addition, touch points will disappear in areas specific to m-business activities. Thus, it is likely that mobile business will redefine the process of value creation. The ultimate skill of an airline in order to obtain a sustainable competitive advantage is the ability to manage its technological infrastructure, to implement common standards such as TCP/IP and to integrate sub-systems into an efficient and effective network. E-business has started to emphasize the importance of this, and mobile business will expedite the formation of systems

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<sup>&</sup>lt;sup>168</sup> The use of wireless devices is currently prohibited by FAA regulations because of possible interference with flight systems, yet from a technological perspective it would be possible to implement an infrastructure in planes that allows the use of such devices (WLAN etc.)

integration into a key success factor. As all airlines require outside technology vendors to some extend, although some large carriers try to focus an in-house strategy for technology acquisition, mobile business will require an airline to function primarily as internal technology consultants and managers of technology portfolios.

Another step in the evolution of an airline's value chain occurs with respect to industry convergence. It is very unlikely that airlines will operate independent wireless networks. Thus, they need to provide applications and content to telecom network providers charging for airtime or amount of data transfer. By creating a profit sharing model and alliances with network operators, airlines could explore a new revenue stream by charging customers for the use of their mobile applications, possibly presented as "micro-payments" in the monthly phone bill. In addition to providing applications, airlines could also emerge into content providers and mobile portals. If an airline succeeds in establishing itself as a portal, this may yield significant loyalty effects with respect to customers who are also mobile users. The possibilities outlined in this paragraph could lead to the convergence between the value chains of airlines and operators of wireless networks (Please see "M-Business Value Chain" C.1.5).

### C.3.2.4 Mobile Application in the extended Value Chain

Besides airlines, also other participants in the travel chain have adopted mobile applications in order to increase customer loyalty and satisfaction.

### C.3.2.4.1 Sabre Inc.

Sabre's "Virtually There" offers travel information such as itineraries, schedules, gate information as well as weather information. These services are provided free of charge to airlines and travelers. They can be received on Palm PDAs, mobile phones, and BlackBerry pagers. Customers choosing wireless phones as preferred media are also able to receive voice notification for travel alerts available in different languages. Additionally, Sabre offers value added features such as a currency conversion calculator. Sabre is also looking for partners for its mobile travel applications outside the travel chain. The company recently announced a partnership with Motorola, which is aimed to enhance Motorola's Mobile Office Solution with capabilities of Sabre's "Virtually There" product line. 170

### **C.3.2.4.2 Expedia**

Expedia uses a mobile application provided by AvantGo for customers using PDAs on either Palm or Windows CE operating system. Information made available includes itineraries, schedules, fight status updates, directions, contact information, frequent flyer numbers as well as hotel availability.

<sup>169</sup> Airlines International, September-October 2001, 34.

<sup>&</sup>lt;sup>170</sup> "Sabre, Motorola Team for Wireless Travel Service", DMNews, August 22, 20001.

# C.3.2.4.3 Worldspan

Worldspan offers flight and reservation information, itineraries, and travel data. The company uses technology provided by HandsOn Network. An additional service made available through Worldspan is the rental of mobile phones when traveling abroad.

## C.3.2.4.4 Travelocity

Travelocity offers a wireless service that allows customers to book flights via WAP or PDA running on palm operating system. Other mobile services include flight status, schedule and itinerary information. Customers are also able to change existing reservations using a wireless device.

## C.3.2.4.5 Thrifty Car Rental

In a move to make car booking easier, the company set up wireless access for Palm PDAs to its reservation system. The application was developed for \$100,000. 15 percent of customers have downloaded the application software to their devices. The company sees the main benefit of this technology as the customers' ability to confirm reservations. Thirty percent of reservations are made over the Internet but the company does not track the number of bookings made through a wireless device. 171

<sup>&</sup>lt;sup>171</sup> "Leading the way to wireless", Computerworld, September 24, 2001.

#### C.3.2.4.6 **UPS**

UPS has been using wireless technology for real time package tracing. In a \$100 million initiative, the company plans to enhance wireless infrastructure to streamline and standardize tracking processes. UPS will install a Bluetooth based network for mobile scanning devices. In addition, advanced wireless local area networks will be installed to improve communication between worldwide facilities and corporate systems.

#### C.3.2.4.7 **FAA**

The FAA launched a service sending travelers real-time airport status information by e-mail. The wireless service is available on PDAs, cell phones, and pagers. 172

#### C.3.2.4.8 **Best Western Hotels**

As an extension of its e-commerce strategy, Best Western established wireless access to search for hotels in a particular region, check for room availability on any given dates, or look up toll-free reservation numbers. The service is available on mobile phones, PDAs, and pagers. The application was provided by 2Roam, a wireless provider located in Redwood City, California, Best Western is considering offering wireless booking by the end of 2002. 173

Airwise News, May 3, 2001.
 "Best Western Sets Up Housekeeping on Wireless Web", CRMDaily, November 2, 2001.

#### C.3.3 SUPPLIER RELATIONS

# C.3.3.1 <u>Technology Acquisition Strategy</u>

When acquiring new technology, companies are facing the decision whether they should attempt to develop the technology internally, or whether it would be recommendable to acquire it from external sources. The main problem when focusing on an internal strategy is that very high costs may be associated with R&D. Also, if the development of the desired technology is clearly not the focus of a company's core competencies, firms may shift the strategic focus towards an external acquisition as outside suppliers might develop the technology more efficiently and to pass part of the resulting cost savings onto the acquiring company. Lenctot and Swan (2000)<sup>174</sup> examined technology strategies of multinational firms in the US market in terms of a company's success. Success is analyzed in terms of strategic positioning advantages (cost, quality, speed to market) as well as taking marketing and economic measures (such as market share) into consideration. They conclude than the reliance on external technology provider has a negative impact on strategic positioning as well as on marketing factors.

### **C.3.3.2 Mobile Application Providers**

<sup>&</sup>lt;sup>174</sup> A. Lanctot, K S. Swan, "Technology acquisition on an internationally competitive environment", Journal of International Management, Vol. 6, 2000, 187-215.

In terms of pursuing a mobile technology strategy, US airlines demonstrate different strategic approaches. Among the airlines that clearly focus on "in-house" development are Delta Airlines and United. In the case of American Airlines, the strategy is not quite as clear because AMR spun of its IT subsidiary Sabre Tech.

In general, there appears to be no obvious relationship between technology strategy and innovativeness. However, it should be noted that second-tier carriers were the first movers to implement a mobile business model for check-in. As one could argue that mobile check-in is the most innovative mobile application currently available in the US airline industry, this would suggest the assumption that the "in-house" technology strategy has not led to an increased level of innovativeness. Alaska Airlines and American Trans Air have relied on external sources for the implementation of wireless applications. The WAP based check-in and boarding solution was developed by Sabre Technologies. For other mobile applications (such as flight paging), Alaska uses an application provided by Everypath Inc. that also provides its product to America West Airlines. Northwest Airline's mobile travel application is provided by AvantGo. Frontier Airlines acquired its flight information application from EDS.

Airlines focusing on internal technology development have also employed third party developers to a certain degree. Delta Airline's virtual check-in was developed by Delta Technologies. Yet, its initial flight paging application was jointly developed with IBM. United's mobile applications are provided by its IT subsidiary United Networks Inc. The company is in charge of United's e-commerce and wireless strategy, operations, and planning. Recent enhancement

of the travel alert service are realized partnering with Centerpost Corp., which has implemented its XML-based SmartDelivery electronic messaging technology into United's application. American Airlines has adopted its flight status and baggage claim application, which is based on Sabre's Travel Management Solution, partnering with Appriss Inc. and MarchFirst Inc. Handheld devices that American uses to check-in passengers wirelessly are provided by Symbol Technologies and are based on Sabre's "Roving Agent" solution, which enables mobile access to Sabre's mainframe booking and reservation engine via a wireless local area network (WLAN). Another carrier to acquire the Roving Agent technology was Jet Blue Airways. The company partnered with Datavision-Prologix and Barcode Products Pty to customize the Roving Agent application. The main player in the field of process oriented mobile business applications seems to be Sabre Technologies. The company's strategic focus with respect to process oriented mobile business applications is on implementing biometric technology into the airport chain. 175

<sup>&</sup>lt;sup>175</sup>Based on information from Passenger Terminal Expo, October 17, 2001.

## C.4 SOCIAL/ POLITICAL ENVIRONMENT

#### **C.4.1 GOVERNMENT**

Governmental influence on the availability of mobile business solutions in the airline environment addresses two interconnected regulatory aspects; the airline industry and the telecommunication industry. In terms of airline regulation, immediate influence originates from security requirements. On the other hand, regulatory issues concerning the telecommunications industry affect the availability of 3G networks, an important factor concerning m-business capabilities.

### C.4.1.1 Airline Regulation

If wireless devices are to be used as business tools in the US airline industry, it is crucial that mobile applications comply with general security requirements. These requirements are in particular amended by the transport Security Administration (TSA), a newly formed branch of the US Department of Transportation. Further regulatory power is provided by the Federal Aviation Administration (FAA). Its regulations usually carry the status of a law.

### C.4.1.1.1 Aviation Laws and Bills

# C.4.1.1.1.1 <u>Legal Framework</u>

The legal framework affecting security procedures of US airlines and airports is documented in the Federal Aviation Regulations (FAR). FAR Part 107 regulates airport security. Air carrier related security regulations are described in FAR Part 108. This section also outlines procedures and measures with respect to passenger and baggage screening, handling of security threats, as well as prevention of hijacking and sabotage attempts. The However, FAR regulations only describe a set of rather broad requirements, individual airports and carriers are responsible to design their own detailed security program and plans. The content of these programs has to be approved by the Office of Civil Aviation, which is part of the Federal Aviation Administration (FAA). Once approved, airports and carriers are required to comply with their programs. Responsabilities for security have now been transferred to the Transport Security Administration (Please see "New Security Measures, p104).

### C.4.1.1.1.2 Enhanced Airplane Security Program

The FAA has initiated an Enhanced Airplane Security Program under which Federal Funds are made available to US air carriers to improve flight deck security. This program is part of the \$500 million initiative announced by President Bush to increase national security. Any carrier holding a US operating certificate and conducting passenger-carrying operations is eligible for funding. A

<sup>&</sup>lt;sup>176</sup> Federal Register, FAR 108-Airplane Operator Security, Oct. 10, 2000.

<sup>177</sup> Civil Aviation Security, http://cas.faa.gov/esp.html

Rapid Response Team reporting to the US Secretary of Transportation evaluates funding requests. Enhancements that qualify for FAA funding include the installation of cockpit doors restricting unwanted entry of persons, the upgrade of transponders to transmit signals during emergency situations, the installation of video cameras monitoring the cabin, as well as hijacking and security related training for flight crew members. A pilot program allocates \$20 million, half of which are paid out upon approval of a carrier's application for participation. The remaining half will be made available upon successful implementation of described security measures. <sup>178</sup> Delta Airlines has been the first carrier to announce tests of video surveillance and enhanced transponder systems. Security upgrades on cockpit doors are already in place by various carriers, <sup>179</sup> such as American Airlines, Southwest, and Alaska.

## C.4.1.1.1.3 Airport Improvement Program:

The Airport Improvement Program (AIP) is administered by the U.S.

Federal Aviation Administration and provides funds to US airports and airport sponsors to improve the environment in terms of safety, security and efficiency. Airports applying for project funding under the program are evaluated by the FAA. After the September 11 attacks, funding will almost exclusively be granted for airport security measures such as the improvement

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<sup>&</sup>lt;sup>178</sup> FAA, www.airweb.faa.gov/airplane\_security/announce.htm

<sup>&</sup>lt;sup>179</sup> "Delta To Begin Testing Enhanced Transponder, Cabin Video Surveillance Systems", Aviation Daily, Oct. 31, 2001.

<sup>180</sup> http://www.faa.gov/arp/520home.htm

and implementation of passenger and baggage screening technology. A large portion of funds is expected to be granted for purchasing fingerprinting machines that will speed up the background checks of airline and airport employees. 181

# **New Security Measures**

Immediately after the attacks, the US Department of Transportation (DOT) closed US airspace and amended all aircraft currently in the air to land. After a 2 day complete closure, US airports were gradually allowed to reopen after proving compliance with new security measures set in place by the Federal Aviation Administration. Following the attacks, the FAA prohibited curbside check-in as well as off-airport check-in. Meanwhile, curbside-check in has been resumed at some airports with FAA approval granted on an airline-by-airline evaluation. Additional security measures address the minimum distance of passengers from terminal buildings, the access to restricted areas, the increase in passenger screening, and further restrictions on carry-on items.

<u>Distance to Terminal</u>: No vehicles are allowed to park within 300 feet of the terminal building.

<u>Access to restricted areas</u>: Only ticketed passengers are allowed beyond security screening points. All passengers have to show their boarding passes at screening points. Passengers traveling on electronic tickets are required to show

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<sup>&</sup>lt;sup>181</sup> "The New World of Aviation", Jane F. Garvey's Speech, Oct. 17, 2001.

<sup>&</sup>lt;sup>182</sup> FAA Office of Public Affairs, www.faa.gov/apa/pr/pr.cfm?id=1435

written flight documentation such as an itinerary issued from the airline or travel agent.

Security Screening: Screening is intensified in terms of the number of passengers and items. Already before September 11, Airlines have used passenger profiling in an attempt to single out suspicious subjects for extensive screening. Based on computerized profiles, the number of passengers submitted for such extensive screening has now been increased. The level of sensitivity of screening devices has also been increased. Additional screenings of electronic items, such as cell phones and laptop computers are conducted more frequently. Carry-on items: Passengers are limited to one piece of carry-on baggage.

Various items have been added to the list of articles that are prohibited to be carried onto the aircraft. Among these items are knives of any kind, cutting instruments (scissors, ice picks, straight razors etc.), golf clubs, ski poles, and hockey sticks.

### C.4.1.1.1.4 Aviation and Transportation Security Act

The main government objective with respect to the airline industry has been to restore public confidence in air transport in terms of safety, security, and stability. <sup>184</sup> In order to achieve this, the US government has created the Aviation and Transportation security Act", which US congress passed in November

<sup>&</sup>lt;sup>183</sup> "Airlines comparing passenger names against list of suspects, CNN.com, Oct 29, 2001.

<sup>&</sup>lt;sup>184</sup> Airwise News, Minetta Speech, Sept 20, 2001.

2001. The new law addresses the federalization of security screening personnel, the deployment of air marshals, and baggage screening procedures, among other issues. Deficiencies in the airport security system related to airport employees have remained eminent despite increased security measures in place since the reopening of the US airspace. Such deficiencies, known for over a decade, include sluggish background checks on employees and poor training. Private security companies have been offering extremely low salaries. The average annual turnover rate has been found to be 126 percent, reaching peaks of up to 416 percent. 186 The new law makes airport security a direct federal responsibility. 187 Within one year, screening personnel will become federal employees who are required to be a US citizen. After a period of two years. however, airports are able to petition to return baggage screening to a private company under supervision of the "Transportation Security Administration", if the company fulfills the requirements outlined in the security act. The authority over rules governing civil aviation security has recently been transferred from the Federal Aviation Authority (FAA) to the Transportation Security Administration (TSA), 188

Another measure described in the act is the employment of air marshals.

The Air Marshal Program was first initiated in the 1970s in response to potential hijacking threats to Cuba. The current program has been in affect since the

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<sup>&</sup>lt;sup>185</sup> United States Congress, Aviation and Transportation Security Act", January 3, 2002.

<sup>&</sup>lt;sup>186</sup> "Organized labor divided over airport security", CNN.com, Oct. 30, 2001.

<sup>&</sup>lt;sup>187</sup> Holland, S. Bush Signs Law Oedering Federal Baggage Screeners. Yahoo News, November 19, 2001.

<sup>&</sup>lt;sup>188</sup> Airports, New York, Feb. 26, 2002.

hijacking of a TWA flight in 1985<sup>189</sup>I. Yet given a decline in terrorist threats, the number of active marshals flying on planes has been reduced to only a few. After the September attacks, the FAA is in process to re-launch the program and is currently recruiting prospect marshals, especially from other government organizations such as Customs, Border Patrol, and Justice Department.<sup>190</sup> Since it is unlikely that air marshals will be available on every flight, numerous US airline pilots have asked to be granted authority to carry weapons or stun guns on board. However, until now no decision has been made on this issue whether flight crews should be equipped with defensive weapons, and if so of what kind.

In addition to the measures described above, the security act also requires complete bag matching and all checked baggage to be screened by devices capable of detecting explosives by December 2002. Furthermore, the Computer Assisted Prescreening System will be used to screen all passengers. An extension of this is voice stress analysis, which seeks to recognize individuals posing a danger. The new law also suggests the introduction of a "trusted passenger program" allowing prescreened individuals to move quicker through the security process. Therefore, the government is discussing whether to issue "trusted passenger ID cards". <sup>191</sup>

<sup>&</sup>lt;sup>189</sup> "Government rushes to put sky marshals on US jets", CNN.com, Sept. 22, 2001.

<sup>190 &</sup>quot;Sky marshals to fly again on jet liners", The Miami Harald, September 18, 2001.

<sup>&</sup>lt;sup>191</sup> United States Government. New Airport Security Measures. Info/Resources, November 11, 2001.

## C.4.1.1.2 Biometric Standard for Airport Security

The public discussion of US policy with respect to airport security has emphasized the need for biometric technology to be employed in US airports. Airports are eligible for public funding for the installation of biometric technology. Boston Logan Airport, for example, has announced its intention to adopt face-scanning technology, which is one of the most favored standards besides fingerprint authentication. Discrepancy exists with respect to the type of biometric technology to be implemented. Yet, in order to be effective, lawmakers are stressing the need for common industry standards for biometric security measures. The US government is currently discussing legislation on an "Aviation Security Technology Enhancement Act". This act would seek the development of biometric standards, require the FAA to enact a pilot program in order to test and evaluate emerging technologies, as well as the establishment of a biometric database with terrorist images for use in airline passenger screening.

## C.4.1.1.3 Industry Aid Package

Within days after the September 11 attacks, it became apparent that the US airline industry is facing a major financial crisis. Some carriers' cash reserves were due to run out within days, a serious threat to their future survival. The main reasons for the cash shortage were attributed to the temporary shutdown of the US airspace and a sharp decline in air travel demand, which has led airlines to

<sup>192</sup> Lawmakers Push For Biometric Standard For Airport Security, Aviation Daily, Oct 31, 2001

announce drastic schedule reductions. Planned layoffs have been estimated to amount to around 100,000 in coming months. Only 10 days after the incidents, US Congress approved a \$15 billion aid package, consisting of \$5 billion for immediate cash injection and further \$10 billion in loan guarantees. It also seeks to limit legal liabilities of airlines, especially whose planes crashed in the attacks. After having received federal emergency funding, the U.S. Department of Transportation (DOT) requires US airlines to provide detailed information on service reductions, finances, operations, bookings, and cancellations.

#### C.4.1.2 <u>Telecommunications Regulation</u>

As US wireless carriers are implementing wireless 3G networks in addition to existing 2G networks, frequency spectrum becomes increasingly scarce. The first auctions of frequency spectrum began in 1996 in response to the Telecommunications Deregulation Act. Since then, US Policy on spectrum allocation has been criticized for being inflexible and inefficient. Furthermore, the policy is said to be incapable to keep up with the rapid advances in technology. 195

In order to make frequency spectrum available for 3G networks and "mobile Internet" applications, the US Federal Communications Commission (FCC) ruled

<sup>&</sup>lt;sup>193</sup> "Congress Oks Airline Aid Package", L.A. Times, September 22, 2001.

<sup>&</sup>lt;sup>194</sup> "With Airlines on Relief, The Feds Demand Data", Aviation Week & Space Technology, Oct. 8, 30.

<sup>&</sup>lt;sup>195</sup> "FCC Chief Calls for U.S. Spectrum Policy Overhaul", Wireless NewsFactor, October 24, 2001.

to auction frequencies<sup>196</sup> that are currently used by about 100 analog television stations. The FCC has postponed the date scheduled for the frequency auction several times. A new date has been set for June 19, 2002.<sup>197</sup> U.S. wireless carriers as well as the Satellite Industry Association (SIA) have requested permission from the Federal Communication Commission to acquire frequencies for 3G networks in another spectrum (2500-2690 MHz). As this spectrum is currently used by government and public organizations,<sup>198</sup> the FCC ruled against relocation of current spectrum holders to other frequencies. However, the FCC agreed to allocate further frequencies within this spectrum.<sup>199</sup>

One of the main discrepancies with respect to 3G licenses has centered on the spectrum acquired in a bidding process in 1996 by wireless carrier NextWave for \$4.7 billion. After the company had filed for bankruptcy protection under chapter 11, the FCC reclaimed the licenses in a move to auction them again to wireless carriers desperate to increase spectrum availability. After the US Supreme Court ruled that licenses have to be returned to NextWave the company agreed to sell the major part of its spectrum to several US cellular carriers for \$ 16 billion. The settlement is subject to approval by the Federal Communications Commission urging to see the spectrum being used.

<sup>&</sup>lt;sup>196</sup> This refers to the 700 MHz UHF spectrum. PAX TV is the largest operator in the spectrum with 17 channels.

spectrum with 17 channels. <sup>197</sup> "US Sets Date for Wireless Spectrum Auction-Again", Wireless NewsFactor, October 17, 2001.

<sup>&</sup>lt;sup>198</sup> Among others, the list of organizations include the US military, healthcare, and schools

<sup>&</sup>lt;sup>199</sup> "US Slows Advance of High-Speed Wireless Services", Wireless NewsFactor, September 25, 2001.

<sup>&</sup>lt;sup>200</sup> "NextWave Finalizes Agreement To Sell Its Spectrum Licenses", The Asian Wall Street Journal, November 5, 2001.

#### C.4.2 PUBLIC

There are two aspects with respect to the US public that have an influence on mobile business prospects. One is related to the wireless devices, the other to air transportation.

Even before the emergence of terrorist actions in the US, the major concern for the flying public has been safety and security. A survey conducted by the Air Transport Association (ATA)<sup>201</sup> shows that public perception of air transport safety diverges significantly from actual accident statistics. Risk associated with air travel is perceived disproportionably high. After September 11, the sensitivity with respect to safety and security has obviously increased by a multiple. In addition, uncertainty has been aggravated by recent anthrax attacks leaving everybody in doubt whether public threats are bound for escalation. Currently, "People are scared to death of flying," says Jet Blue's CEO David Neelman.<sup>202</sup> A different scenario is suggested in J.D. Power's 2001 Airport survey, which concludes that nearly two-thirds of airline passengers indicated to be "already comfortable with flying" only five weeks after the September events. 203 In order to revive demand for air travel, the industry as well as the government regards regaining public confidence as absolutely crucial. This also explains the quick moves by US airlines to implement in-flight security measures such as enhanced cockpit doors.

<sup>&</sup>lt;sup>201</sup> ATA is the industry association of US air carriers

<sup>&</sup>lt;sup>202</sup> Aviation Daily, October 31, 2001.

<sup>&</sup>lt;sup>203</sup> J.D. Power and Associates, Yahoo!, Inc. (2001). Domestic Airport Passenger Satisfaction Study. Press Release, October 23, 2001.

Increased concerns of safety and security effect mobile business also in another way. The September 11<sup>th</sup> events may have changed the public view of technologies, one of which wireless communication has gained in popularity. Following the attacks, mobile phone use has experienced a tremendous boost leading to a temporary breakdown of telecommunication infrastructure in some regions. People all across the United States attempted to reach family and friends to find out whether they were unharmed.<sup>204</sup> In addition, mobile phones even played a role in the actual attacks, as passengers of hijacked flights were able to make contact via mobile phones. Already before September 11, the safety factor was perceived to be a key selling factor for mobile phones, as GPS makes it possible to locate phones within 50 feet of accuracy.<sup>205</sup> Mobile phones have become a comforting safety feature resulting in a sales increase after September 11. The trend towards wireless technology as a safety device also becomes apparent as US Congress provided all House members with RIM pagers in order to guarantee communication in emergencies.

#### C.4.3 INDUSTRY AND ASSOCIATIONS

#### C.4.3.1 Biometrics

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<sup>&</sup>lt;sup>204</sup> "Charting Wireless Industry's Course after Sept.11", Wireless Data News, Potomac, October 10, 2001

<sup>&</sup>lt;sup>205</sup> "GPS Cell Phone Alarms Pinpoint Emergencies", Wireless NewsFactor, September 25, 2001.

Traditionally, the term "biometrics" refers to the field of statistical and mathematical methods to analyze biological data comprising of numerous applications ranging from agriculture to human traits.<sup>206</sup> Recently, however, the term biometrics has become frequently used referring to the emerging field of technology associated with the identification of individuals through biological characteristics.

#### C.4.3.1.1 Biometrics in an Airline Context

The possibility to interchange data between different applications (p.e. banks and airports) allows biometrics to be employed broadly in the travel chain. Pequirement for this is the integration of IT systems, which in combination with biometric applications facilitates data exchange and quick access to information. The potential benefit of biometric technologies for airline passengers is preventing them from being repeatedly asked the same questions, having to present their documents at numerous stages in the travel process, and decreasing waiting time at security check-points.

Despite the ultimate goal of IATA and ICAO to pronounce industry wide standards, airlines and airports are likely to offer a variety of biometric programs to their customers. Regardless of which technology is chosen, there appears to be a common trend to segment travelers into "unknown" and "known" ones. In

<sup>&</sup>lt;sup>206</sup> "Definition of Biometrics", Department of Statistics, Texas A&M University

<sup>&</sup>lt;sup>207</sup> "Biometrics & Smart Cards: The future of airline security and passenger convenience, GAMET White Paper, Sept. 2001.

<sup>&</sup>lt;sup>208</sup> B. Sweetman, "E-Commerce after Sept. 11", Air Transport World, Dec. 2001, 63-65.

this case, biometric programs would function as an extension of frequent-flyer programs.<sup>209</sup>

Biometric features are very flexible as they can be installed on smart cards, PDA's, cellular phones, and passports. Most technology providers such as SITA and EDS advocate smart cards for the use of biometrics in the travel chain. Besides identification features, smart cards equipped with biometric data could also serve as payment platform if linked to a credit card database.<sup>210</sup> Physical and behavioral biometric technologies can be distinguished. The list of currently available physical processes comprises of fingerprint analysis, facial recognition, iris scanning, retina scanning, and hand-geometry. Emerging technologies are recognition of voice, hand vein patterns, body coloring, and lip patterns.<sup>211</sup> In the area of behavioral biometrics, features include dynamic signature verification, speech verification, and keystroke verification. A new feature currently being developed is gait (movement) recognition. One of the emerging technologies that is believed to be promising is voice recognition. Yet, for the use in an airport environment background noise reduces the reliability of this technology.

A problem connected to most biometrics is the gradual change of biologic features over time. In addition, changes in light levels or simply placing fingers differently on the scanning device can yield discrepancies between the captured image and the stored data. Iris scanning and fingerprint remain relatively

 $^{209}$  B. Sweetman, "E-Commerce after Sept. 11", Air Transport World, Dec. 2001, 63-65.  $^{210}$  (p. 56)

<sup>&</sup>lt;sup>211</sup> "Security in the air industry", Airlines International, November-December 2001, 54-58

unaffected by aging as these features are preserved over time. Possibilities to account for biological change are crucial to observe when opting for a biometric standard since they can heavily impact on support and supervision cost in a real environment.<sup>212</sup>

## C.4.3.1.2 Tasks of Biometric Technology

Three areas of security can be distinguished on the passenger side: terrorist screening, passenger validation, and passenger identification.

#### Screening

The procedure for terrorist screening requires matching against a database of known subjects since it is not feasible to scan and match all faces on a worldwide level. SITA suggests installing cameras at standard collection points where all passengers have to pass through. Collected images could be stored in an existing LAN (Local Area Network) using a common server executing comparison algorithms. The list of known subjects could be maintained and kept up to date through a wide area network (WAN). However, the logistic challenge resides in the necessity to implement an official list of suspected terrorists. Other problems might be encountered in terms of distribution methods and updating of information. From a technical point of view, problems might occur with respect to

<sup>&</sup>lt;sup>212</sup> "Security in the air industry", Airlines International, November-December 2001, 54-58

positioning of cameras, the maximum number of impressions that can be captured by a device, and unreliable operation in connection with certain biologic characteristics.

#### Passenger Validation

Passenger validation refers to the process of assuring that the person who checked-in is also the person transiting the airport and boarding the plane. The approach is to capture a biometric image during check-in in conjunction with a key. The data is stored to a common server or encoded onto a boarding pass. The biometric imprint can then be checked at security points and at the boarding gate. This procedure, however, requires the general acceptance of biometric measures among the traveling public. Since many travelers today use electronic tickets and biometric images cannot be coded in adequate quality onto common magnetic stripe paper tickets (ATB). Therefore, travelers have to be equipped with a new device equipped with sufficient memory. Possible devices would be smart cards and cellular devices.

#### Passenger identification

In the identification process, biometric cardholders would have to be prescreened through a government agency. When a cardholder arrives at the checkin, certain biometric features depending on the particular program would be compared to the coded imprints in chip of the card. The great advantage of this procedure is that it does not require an "on-line" check against a central database, which is costly as well as time consuming. The problem with respect to biometric cards arises from its relatively high costs, which either the traveler himself or the airline would have to bear, and the question of who should have the authority to issue such cards. This may particularly become an important aspect in countries where the risk of bribing government officials is comparably high.

#### C.4.3.1.3 **Biometric Technologies**

The decision on what biometric device to employ depends on the area of application to a large extent. Challenges connected with passenger authentication are significantly more complex than applications aimed for employee access. This results from the necessity to provide passengers with a convenient and time efficient means impacting the complexity of a biometric solution as well as cost and scope.<sup>213</sup> The following technologies are employed in the airport environment.

#### **Hand Geometry:**

Hand-recognition has been in use in high security areas such as nuclear plants, the stock exchange, and the INSPASS program for US Immigrations. Initiated in 1996, the program allows participating business travelers from

<sup>&</sup>lt;sup>213</sup> www.biometricgroup.com

countries included in the "Visa-Waiver Program" to clear immigrations by identifying themselves through the biometric features of their hand. A dominant vendor of hand-geometry solutions is "Recognition Systems", which describes hand geometry as a relatively mature method for biometric identification yielding accuracy rates of 99.9 percent. In order to identify a person by hand-recognition, over 90 biometric features of the hand are compared with a unique template stored in a nine-byte file. In addition to the applications listed above, the company's "HandKey" solution has been used for ten years at San Francisco Airport for employee access. Furthermore, it is employed at 23 kiosks at Tel Aviv airport generating a monthly throughput of around 40,000 passengers per month.<sup>214</sup>

# Finger Imaging

Finger imaging has been used for background checks of new employees at nine US airports reducing response time to a few hours. Identix, based in Los Gatos, California, is a vendor of such applications at airports. The company estimates the cost of implementing this system to range between \$30,000 and \$60,000 per airport. Another possible application for finger imaging is to control access to secure areas. In the future, finger imaging could also be extended to passengers. Possible applications could be matching biometric images with a database, or storing data on a smart card to ensuring consistent identification throughout the travel process. This feature could also be embedded into a loyalty

<sup>214</sup> "The Biometric Leap for Security", Airlines International, Nov-Dec 01, 36-39

program. Identix assumes that the cost of this application would only amount to about 50 cents per ticket.<sup>215</sup> Vendors of self-service check in equipment such as IER are currently studying the implementation of this biometric at CUSS kiosks.<sup>216</sup>

## **Digital Faces**

This technology is based on the mathematical relationship of facial features such as the distance between eyes, nose, and chin. best suited for scanning large numbers of subjects, such as in public terminals. A digitized version of a photo is broken down into unique codes and compared with the data obtained by scanning waiting lines and airport halls. Results can be obtained nearly instantaneously. A fist version of this technology has been implemented by "Visionics" at Iceland's Keflavik Airport. Partnering with Raytheon, the companies anticipate catering the face-recognition solution to the airline and airport market<sup>217</sup>. The technology can capture up to 15 faces at a time, even if subjects are moving. The advantage of this technology is that it is far less intrusive than other biometric technologies and can be fed with data originating from different sources, such as FBI databases etc. Citing a Harris poll conducted shortly after September 11, 86 percent of respondents indicated to prefer this technology for increasing airport security. However, compared to other solutions,

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<sup>&</sup>lt;sup>215</sup> "The Biometric Leap for Security", Airlines International, Nov-Dec 01, 36-39.

<sup>&</sup>lt;sup>216</sup> IER Systems, Passenger Terminal Expo, Orlando, 2001.

<sup>&</sup>lt;sup>217</sup> Fortune, October 29, 146.

Visionics "Facelt" product is relatively costly to implement. Per airport, implementation costs are estimated around \$1m.

Before introducing face biometrics into the airport environment, this technology has been broadly used in casinos to spot people trying to cheat the system. Another vendor of this technology is Viisage, whose solution considers 128 measurements and is said to be 99.7 percent accurate. The company had originally planned to sell its solution to boarder police and airports. Yet, before September 11, the interest in such technology has never generated any sales leaving the main customer group to be casinos. Recently, a mayor US airport has decided to implement 35 surveillance cameras, terminals, and servers for about \$500,000. The main critique point of this technology is the problem that most current face-recognition systems cannot yield reliable results if the person is more than 15 percent away from the center. Considering the thousands of air travelers passing through an airport per day, the system will generate a high number of false alarms, despite its relatively high accuracy of about one error in 10,000. Passengers may perceive this as intrusion.<sup>218</sup>

In terms of identifying individuals in surveillance mode, this technology may not be very effective. This is caused by the difference in the means of identification, as the resolution of a video image is very different from the one of a photograph or other image that is captured in a database. Secondly, there is a number of external variables that cannot be controlled, such as light conditions and movements. Thirdly, changes over time can limit the reliability of the system. In sum, face recognition by surveillance cameras has the potential to increase the

<sup>&</sup>lt;sup>218</sup> Fotune, 146.

likelihood to spot terrorists, however its limitations suggest that it may not be sufficient as a single means.<sup>219</sup>

## Iris Scanning

Iris scanning is a very accurate technology. The error rate is only once in every 2.8 million checks.<sup>220</sup>The technology has been tested at Charlotte Airport in North Carolina, yet airlines participating in the project have expressed that they have no further plans to use this technology. Continental Airlines, however, is considering the deployment of iris scanning from employees operating in secure areas. In a pilot project at Amsterdam Schiphol airport, iris scanning is available for pre-registered frequent flyers.<sup>221</sup>

## **Voice Recognition**

Voice authentication is the automated verification of a person's claimed identity based on unique characteristics of their voice. The voiceprint measures behavioral characteristics of the way the person speaks and physical characteristics of the vocal tract. The advantage of voice biometrics is that they can be integrated into a phone call and do not require the use of remote devices. Furthermore, the use of voice as biometric method may appear less intrusive to

<sup>219</sup> "What Could Biometrics Have Done?", International Biometrics Group

<sup>221</sup> Privium, available for EU nationals. "Airport Security: Eye-Catching Technology", Frequent Flyer Magazine, Dec. 2001.

<sup>&</sup>lt;sup>220</sup> Airlines International, 56

some people. It requires a caller to enroll by creating a one-time voiceprint, which is stored as a numeric matrix presenting voice characteristics and vocal tract.

Storage of such print typically requires about 20K of memory. "Nuance", a company based in Menlo Park, Ca, specialized in voice recognition solutions, claims that its Verifier" product provides security of 99.9 percent under real conditions. The application simultaneously allows voice recognition and verification and adapts the voiceprint after each application (on-line adaptation). 222

## C.4.3.1.4 Technology Influencers

# **US Government**

The public discussion of US policy with respect to airport security has emphasized the need for biometric technology to be employed in US airports. Airports are eligible for public funding for the installation of biometric technology. Boston Logan Airport, for example, has announced its intention to adopt face-scanning technology, which is one of the most favored standards besides fingerprint authentication. Discrepancy exists with respect to the type of biometric technology to be implemented. Yet, in order to be effective, lawmakers are stressing the need for common industry standards for biometric security measures. The US government is currently discussing legislation on an "Aviation"

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<sup>&</sup>lt;sup>222</sup> Nuance White Paper, Frequently Asked Questions

<sup>&</sup>lt;sup>223</sup> Lawmakers Push For Biometric Standard For Airport Security, Aviation Daily, Oct 31, 2001

Security Technology Enhancement Act". This act would seek the development of biometric standards, require the FAA to enact a pilot program in order to test and evaluate emerging technologies, as well as the establishment of a biometric database with terrorist images for use in airline passenger screening. In terms of defining biometric standards, however, it is probable that the government will leave this task in the responsibility of industry bodies.<sup>224</sup>

#### IATA

In an attempt to streamline passenger processing and to reduce waiting time, IATA has formed a work group called IATA SPT (Simplifying Passenger Travel). A trial project using biometrics for identification has been set in place in London Heathrow Airport. In terms of biometric features to be included into the travel process chain, IATA found that eye scanning technology is internationally least objectionable. The biometric solution has been developed by Virginia based EveTicket Corp. The technology is based on the assumption that each individual's iris is unique. 225 According to Eye Ticket, iris scanning provides the most accurate single factor method for biometric identification.<sup>226</sup> In the first phase, iris scanning will only be used for immigration clearance since implementation into the passenger check-in and boarding process would be more difficult. According to IATA, the image of a person's irises could also be

<sup>224</sup> Airline Business, Feb. 2002, 37

<sup>225</sup> "Hide and Seek", Airline Business, October 2001, 36.

<sup>&</sup>lt;sup>226</sup> "EveTicket Corporation and IATA SPTIG UK Regional Group Announce Groundbreaking Passenger Processing Trial, July 26, 2001 (www.eyeticket.com)

digitized and stored on wireless devices such as PDAs, pagers, or smart cards.

This would allow iris scanning to be implemented in various airport related processes. A possible application is self-service check-in.

In addition to biometric applications, IATA's SPT group has also conducted research and trials with smart cards containing information such as travel history and identity. In order to standardize smart cards, IATA has pronounced minimum industry standards in its Resolution 791, which describes specifications for "Integrated Circuit Cards". These cards are commonly used for electronic ticketing.<sup>228</sup>

CUSS Kiosks (Common Use-Self-Service) can be equipped with biometric scanning devices supporting applications such as finger print recognition, iris scanning and face recognition. <sup>229</sup>

## **ICAO**

ICAO has been working in cooperation with ISO<sup>230</sup> to establish worldwide standards for biometric identification. Due to the importance biometrics have gained for airport security after September 11, a working group was formed studying possibilities to pronounce industry standards; a report is due to be released in spring 2002.<sup>231</sup>

<sup>227</sup> "Insight on IATA", Airlines International, September-October 2001, 69.

<sup>&</sup>lt;sup>228</sup> "Technology: Its Effect on Travel Distribution and Service", Handbook of Airline Marketing, 1998, 459.

<sup>&</sup>lt;sup>229</sup> Insight on IATA", Airlines International, Vol. 7, Iss. 8, November-December 2001

<sup>&</sup>lt;sup>230</sup> International Standardization Organization

<sup>&</sup>lt;sup>231</sup> "Lasting Impressions", Airline Business, Feb. 2002, 36.

The basis for ICAO's involvement is the apparent trend among governments, airlines, airports, and their industry partners to enhance service and process automation. Automation efforts involve technologies and equipment increasingly employ biometrics. ICAO's approach seeks to store biometric data on a smart card. Facial biometrics is most likely to be selected for ID confirmation in conjunction with a travel document that can be read with a machine<sup>232</sup> (MRTD-Machine Readable Travel Document). With its MRTD program, ICAO hopes to contribute to increase service quality and airport security, while at the same time ensuring global interoperability.

An evaluation of possible biometrics concluded that face biometrics is the most likely method to be selected for achieving this goal.<sup>233</sup>

In response to recent events in the United States, ICAO has adopted a resolution to increase safety and security of international civil aviation. Part of the resolution is a full review of security conventions, which contain internationally approved security standards and recommended practices and procedures (SARPs). Furthermore, the resolution suggests funding for states to implement and upgrade security measures.<sup>234</sup>

#### SITA

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<sup>&</sup>lt;sup>232</sup> "Face-the emerging biometric ID for MRTDs", Airport World, Vol. 5, Iss. 6, Dec-Jan 2000/2001, 49-53.

<sup>&</sup>lt;sup>233</sup> Airport World, Vol 5, Iss. 6, Dec-Jan 2000/2001, 49.

<sup>&</sup>lt;sup>234</sup> "Meeting Caps most productive triennium in recent ICAO history" ICAO News Releases, October 5, 2001, Montreal.

SITA is planning to include biometric applications into their CUTE (Common Use Terminal Equipment) platforms, such as check-in desks and self-service kiosks.<sup>235</sup> The idea is to design systems able to recognize various biometric measurements. This is assumed crucial for backup in case of irregular operation or if one method is infeasible for a certain passenger.

#### C.4.3.1.5 Biometrics for M-Business

Especially for m-business transactions, voice recognition is regarded as a potential technology to increase security. The voice recognition application is based on the "verifier" product provided by Nuance. <sup>236</sup> InterVoice-Brite offers a voice based e-business platform that combines voice biometrics with a PIN number and other identifying information to provide mobile authentication and identification solutions in the financial, travel, and entertainment industries. <sup>237</sup> Of special interest for m-business related biometric applications is the possibility to integrate a reading device into a cellular phone or PDA. "AuthenTec's" small biometric sensors <sup>238</sup> for fingerprints biometrics is already available for mobile devices operating under the "Symbian" operating system. Integration into Windows CE and Palm OS is planned for early 2002. <sup>239</sup>

<sup>&</sup>lt;sup>235</sup> http://www.sita.net/industries/airport/common\_use/index.asp

<sup>236</sup> www.nuance.com/partners

<sup>&</sup>lt;sup>237</sup> J. Wrolstad, "Voice Recognition Employed for M-Commerce Security", WirelessNewsFactor, Feb. 1, 2002.

<sup>&</sup>lt;sup>238</sup> EntrePad AES3500, measuring 6.5mm by 6.5mm

<sup>&</sup>lt;sup>239</sup> L. Hirsch, "Tiny Biometric Sensor offers Security on the Go", Wireless Newsfactor, Dec. 5, 2001.

## C.4.3.1.6 Applications in the Travel Chain

Most current applications of biometrics can be found in the field of employee access to secure areas. There has been a public discussion whether or not biometrics could have prevented the attacks on September 11. The answer to this, however, remains controversial. At this point, there seems to be no industry wide support for adopting biometric solutions. This may be attributed to the lack of reliability and high capital expenses necessary for the implementation of these technologies. Furthermore, US airlines have made it a policy not to compete against each other on security. Janet Weiman, CIO of Continental Airlines, has pointed out that the implementation of biometric initiatives will take time and financial resources. In contrast to high expenses, ROI is rather slow and difficult to measure.<sup>240</sup>

The list provided below describes applications of biometric technologies in the airport and travel environment.

<sup>240</sup> J. Maselli, "Coming to an airport near you", Information Week, Nov. 12, 2001

Figure 10: Biometrics in the Travel Chain

Project / Location	Vendor	Technology	Apı	olication
Heathrow Airport London, England	EyeTicket	Iris-scan	Access Control	Passenger authentication at airport
Schiphol Airport Amsterdam, Netherlands	Privium	Iris-scan	Access Control	Passenger authentication at airport
INSPASS 8 U.S. and Canadian airports, including LAX, JFK	Recognition Systems, Inc.	Hand-scan	Access Control	expedite immigration lines
Keflavik International Airport Iceland	Visionics	Facial-scan	Surveillance	Passenger surveillance against "hotlist"
San Francisco Int'l Airport San Francisco, CA	Recognition Systems, Inc.	Hand-scan	Access Control	Employee access in airport
Ben Gurion Airport Israel	Recognition Systems, Inc.	Hand-scan	Access Control	Israeli citizens circumvent lines
Immigration and Asylum Fingerprint System (IAFS) United Kingdom	SAGEM	Finger-scan	Public Services/ Citizen ID	1:N checks of asylum seekers, immigrants
O'Hare Airport Chicago	Identix/ SecuGen	Finger-scan	Access Control	Employee cargo access
Charlotte/Douglas Airport North Carolina	EyeTicket	Iris-scan	Access Control	Employee access in airport
IDENT U.S. – Mexico Border	Various	AFIS, facial- scan	Public Services/ Citizen ID	Illegal immigrants checked for prior offenses
Reagan National Airport Washington, DC	Identix	Live-scan fingerprinting	Employee Background Checks	Pre-employment background checks

Source: Based on "International Biometrics Group"241

## C.4.3.1.7 Critics

The main issue with respect to biometrics arises from privacy concerns and a potential threat of data abuse. The trade-off between privacy and security may not be justified since it is not clear that biometrics actually solve the security

<sup>&</sup>lt;sup>241</sup> http://www.biometricgroup.com/e/Brief.htm

problem. In an airport context, the trend towards pre-screening passengers brings a two-class system, which some argue, should not be an objective in terms of security.<sup>242</sup> Furthermore, critics of this procedure have pointed out that the underlying assumption pre-screened passengers could be mutually excluded as risk factors may not be bearable. Certain technologies can provoke objections on a cultural level. In some cultures, for example, it is objectionable to touch something such as a fingerprint reader since it has been touched by many people before. Since the rollout of biometric technology will for practical reasons be limited to a few participating countries, there is a risk that biometrics become a means to justify discrimination against people based on nationality.

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<sup>&</sup>lt;sup>242</sup> J. Sharkey, "Class Consciousness Comes to Airport Security", The New York Times, Jan 6, 2002.

# **C.5 ECONOMIC ENVIRONMENT**

#### C.5.1 US Economy

Long-term economic forecasts had predicted the worldwide economy to grow at an annual rate ranging between 2.5 and 3.0 percent.<sup>243</sup> Adjusted after the September 11 attacks, the US economy is forecasted to grow at a rate of 1.1 percent in 2001 and 1.0 percent in 2002.<sup>244</sup> These figures, however, is controversial among economic forecasters. The dominant opinion appears to be that economic effects resulting from the terrorist attacks are rather modest and short-lived. Monetary and fiscal policy is seen to provide an important buffer to limit negative effects on the US economy. While many forecasters believe that the US economy as well as the stock market will rebound in 2002, optimism abroad is not as common. Especially in Europe, analysts have tended to attribute the US economic weakness on structural problems one of which is a record account deficit of 4.5 percent of GDP; this could make the dollar vulnerable to a shift in international capital flows.<sup>245</sup> Uncertainty in the stock market had already been pronounced by the slump of high tech stocks in 2000. According to the chairman of the US Federal Reserve Bank, the uncertainty arising from terrorist attacks is likely to impose a further burden on the US economy. Yet, initial shocks are seen to wear off.<sup>246</sup> In spite of recent economic data, the stock market has remained stable. In addition, the dollar exchange rate has kept firm against

<sup>&</sup>lt;sup>243</sup> The Economist, July 2001.

<sup>&</sup>lt;sup>244</sup> "Global Economy to Grow 1.6 Pct in 2002: World Bank", Jiji Press English News Service, Nov. 1, 2001, Tokyo.

<sup>&</sup>lt;sup>245</sup> "Who is right about the US economy", Financial Times, November 5, 2001.

<sup>&</sup>lt;sup>246</sup> "Investors see vision of recovery", Financial Times, October 30, 2001.

the Euro and the Japanese Yen. Despite the continuing slide in industrial output, which has been the longest since the Second World War,<sup>247</sup> recent economic data has not been as devastating as many had feared. This is broadly attributed to sustained- although moderate- growth in household spending, increased spending in the public sector, and relief in tax payments.

The real gross domestic product, encompassing goods and services produced by labor and property in the US, has decreased at an annual rate of 1.1 percent<sup>248</sup> in the third quarter of 2001. This figure presents a revised estimate of the figure of negative 0.4 percent, which had been published earlier.<sup>249</sup> This third quarter contraction of the US economy is in contrast with the 0.3 percent increase reported in the second quarter of the year.<sup>250</sup> In 2000, the GDP was calculated to be 4.1 percentage points. The current decline resembles the first negative growth in 10 years. Many forecasters expect negative GDP growth to continue throughout the fourth quarter. In this event, the US economy would be technically in recession.<sup>251</sup> The main factors attributing to the third quarter decline are a 16 percent decrease in exports and low investments in the private sector. For the second time in 2001, imports have exceeded exports leading to a positive figure in net exports. A major part of private investment decrease is attributed to information processing equipment and software. However, a part of negative

<sup>&</sup>lt;sup>247</sup> "Investors see vision of recovery Global Outlook", Financial Times, October 30, 2001.

 $<sup>^{248}</sup>$  The 70% confidence interval ranges from -1.0 to 0.5 percentage points based on historic data

<sup>&</sup>lt;sup>249</sup> US Department of Commerce, News Release, November 30, 2001.

<sup>&</sup>lt;sup>250</sup> Bureau of Economic Analysis (BEA)

<sup>&</sup>lt;sup>251</sup> Recession is defined as negative GDP growth in two consecutive quarters.

affects on GDP growth is assumed to have been offset by Federal government spending and personal consumption expenditure.

Federal spending increased 4.6 percent in the third quarter, compared to an only moderate increase of 1.8 percent in the second. Real personal consumption expenditure increased 2.5 percent in the second quarter of 2001. In the third quarter, the increase of 1.1 percent was more moderate. In September, personal consumption expenditure decreased by 1.8 percent.<sup>252</sup>

Personal Income has increased marginally posting an increase of less than 0.1 percent in current-dollars values. Personal disposable income (Personal income less personal tax and non-tax payments) has been falling for the first time in six years reflecting a 1.1 percent decrease in September. There have been several affects besides the September 11 attacks on personal income. The main factors are lowered net income tax payments and advanced tax refunds as part of the "Economic Tax and Relief Reconciliation Act of 2001". The importance of personal income for the US airline industry becomes clear when considering that air traffic growth is closely related to economic growth and income. This economic relationship is supported by Tretheway and Oum (1997)<sup>253</sup>, who have found the elasticity for air travel with respect to income to be approximately negative two.

<sup>&</sup>lt;sup>252</sup> "Gross Domestic Product: Third Quarter 2001", US Department of Commerce, October 31, 2001.

<sup>&</sup>lt;sup>253</sup> "Winning Airlines", T. H. Oum, C. Yu, Kluwer Academic Press, 1997, 5.

Reflecting the overall performance of the US economy, unemployment has risen to its highest levels in four years. Compared to other industrial countries, however, the US figure of 4.5 percent is still relatively low.<sup>254</sup>

The latest data on inflation revealed an increase in consumer prices by 2.6 percent for the year ended in September<sup>255</sup>. Seasonally adjusted, the CPI increased by 0.4 percentage points in September followed by a 0.1 percent increase in August.<sup>256</sup> Cost for Transportation increased slightly by 0.5 percent for the 12-month period. Airline fares, which are a component of transportation cost, have decreased since June posting a drop of 0.7 percent for September.<sup>257</sup> (A more detailed analysis is presented below in the paragraph " US Airline Industry")

## C.5.2 US Wireless Industry

Telecommunications is one of the most rapidly growing industries worldwide. While fixed line communication networks are still subject to governmental regulation, the wireless industry in the US is facing an intensely competitive environment. Numerous mergers have occurred since the introduction of industry deregulation in 1996. Verizon Wireless, the largest mobile carrier, for example is comprised of GTE Wireless and Bell Atlantic Corp. Since demand for telecommunications is related to personal income and economic

<sup>&</sup>lt;sup>254</sup> "Who is right about the US economy", Financial Times, November 5, 2001.

<sup>&</sup>lt;sup>255</sup> CPI for all Urban consumers (CPI-U)

<sup>&</sup>lt;sup>256</sup> US Department of Labor Statistics (www.bls.gov)

<sup>&</sup>lt;sup>257</sup> 12-month period unadjusted for seasonality.

growth, Wireless carriers as well as handset manufactures have noticed a reduction in profits due to effects of the "shaky" economy. Motorola, the largest US handset manufacturer, announced the layoff of 7000 employees. The majority of mobile carriers do not seem to expect a rebound in the US economy in the near future. Verizon Wireless expects the negative trend to lead to a low point in the middle of 2002. In the third quarter of 2001, Verizon reported earnings of \$ 1.9 billion, compared to \$ 3.5 billion the year before. Revenues, however, have increased by 2.8 percent in 2001. Verizon's direct financial damage attributed to the September 11 attacks is estimated between \$1.7 and \$1.9 billion. Insurance companies, however, will cover most of this. 259

#### C.5.3 US Airline Industry

Boeing as well as Airbus forecast global air traffic to grow at about 5 percent per year until 2010. Although this presents a rather slow growth rate, the figures well exceed predicted growth for the overall economy. Yet, with the downturn of the US economy financial pressure on the airline industry has increased. Although the US airline industry has been heading towards a downturn since the beginning of 2001, recent events accelerated distress by a multiple. Cyclicality is a typical characteristic of this industry. Usual cycle time is ten years consisting of three to four years of crisis, followed by five to six years of

<sup>258</sup> Wireless NewsFactor, November 2, 2001.

<sup>&</sup>lt;sup>259</sup> "Verizon Sees Net Skid 46%, Cuts Forecasts", The Wall Street Journal, October 31, 2001, B6.

profitability. <sup>260</sup> Internal and external factors causing distress in the US airline industry can be differentiated. External factors are liberalization of bilateral agreements, increasing prices of jet fuel, <sup>261</sup> and a downward sloping economy. Internal factors are alliance building and consolidation leading to increased competition and overcapacity and labor disputes. As most input factors are fixed, labor becomes a major cost differentiator for airlines competing in the same market. This has lead to a trend towards downsizing of the workforce, outsourcing, and changing business processes. Another main cost factor relates to distribution systems. Especially in the US, there has been a trend to decrease the number of intermediaries by direct sales and a focus towards e-commerce. Another development is the refocus among major carriers on core market segments ending diversification efforts. US Airways and United have ended their low cost subsidiaries and Delta has cut back 50 percent of its Delta Express subsidiary. <sup>262</sup>

The US airline Industry expects net losses attributed to the terrorist attacks to amount to \$ 5.6 billion. UBS Warburg estimates the financial impact to be \$ 3 billion after tax for 2001. This figure is based on lower revenue assessment, despite reductions in labor costs and capacity. In the history of US civil aviation, airline revenues have typically recovered within less than a year after an event. This has been the case since the 1930s. Yet, the revenue impact

<sup>&</sup>lt;sup>260</sup> R. Doganis, Airlines International, Vol. 7, Iss. 3, May-June 2001.

<sup>&</sup>lt;sup>261</sup> Between 1998 and 2000 jet fuel prices have increased by 110%, in real terms prices are at the same level as 1990.

<sup>&</sup>lt;sup>262</sup> "Low-fare exit for majors", Airline Business, November 2001.

<sup>&</sup>lt;sup>263</sup> In discussions over a federal aid package, US airlines claimed the impact to exceed twice this amount.

of the September 11<sup>th</sup> attacks is forecasted to be a multiple of the impact pbserved in connection to prior events<sup>264</sup>. Immediately after the attacks, about five US airlines were assumed potential bankruptcy candidates. Air Tran and Continental Airlines had remaining cash reserves for 15 days. Also America West, Northwest, and US Airways were assumed facing an uncertain future, later joined by United.

Revenues of US airlines decreased by 45 percent in September. This was caused by a drop in traffic volume of 32 percent and a 19 percent decrease in average fares. Severely affected was also transatlantic air traffic, which has decreased by 36 percent after the attacks. Worldwide, load factor fell from 78 percent in August to 69 percent in September. In the first nine months of 2001, world scheduled air traffic decreased 3 by percent, but capacity increased by 2 percent. Recovery of load factors and revenues has been initially slower than anticipated. While load factors have recuperated substantially in the first quarter of 2002, revenues remain significantly below pre 9/11 levels due to the continuing weak recovery of demand for high-yield business travelers. A major factor for this is the increased waiting time at airports, which negatively impacts productivity. Thus, perceived value of air travel has decreased resulting in the

<sup>&</sup>lt;sup>264</sup> UBS Paine Webber, Research Note, Sept 20, 2001.

<sup>&</sup>lt;sup>265</sup> "Airlines Traffic and Fares both fell during September", Wall Street Journal, October 24, 2001.

<sup>&</sup>lt;sup>266</sup> "Transatlantic Air Traffic down 36% after attacks", Financial Times, October 25.

<sup>&</sup>lt;sup>267</sup> "IATA traffic confirms effects on September 11", IATA News Release, October 30, 2001

<sup>&</sup>lt;sup>268</sup> UBS Pine Webber, Research Note, November 14, 2001.

number of business class bookings to be possibly reduced by 50 percent between January 2001 and January 2002.<sup>269</sup>

The highest losses in the industry were reported by United Airlines. American, and US Airways. United's losses are estimated around \$1 billion. The loss was the worst quarterly result in the company's 75-year history. In the same period last year, United posted a more moderate net loss of \$116 million.<sup>270</sup> American Airlines (AMR) reported net losses of \$ 441 million despite having received a \$ 525 government grant. Losses are likely to continue in 2002, where they are assumed to amount to \$ 2.4 billon despite the typical seasonal recovery in the summer. Also Continental, Delta, and US Airways reported steep losses for the third quarter of 2001 ending in September. Before the attacks, Northwest Airlines was one of the few airlines to expect a profit in 2001 despite the economic slowdown. Due to government assistance, Northwest has been able to post a profit of \$19 million in the third quarter of 2001. Without the federal grant, the company would be facing a loss of \$100 million.<sup>271</sup> Besides Northwest, only Alaska Airways and Southwest have been financially stable in terms of credit rating and available cash reserves.<sup>272</sup> In terms of its cash flow position. Southwest was significantly better positioned at the time of the attacks than most of its competitors. It had about \$1 billion at hand. Its debt-equity ratio is only 33.3

<sup>&</sup>lt;sup>269</sup> "Demand for business flights "may halve" air travel", Financial Times, September 25, 2001.

<sup>&</sup>lt;sup>270</sup> "UAL Posts Worst Loss Ever, Working To Stabilize Cash Burn", Aviation Daily, November, 2001.

<sup>&</sup>lt;sup>271</sup> "Northwest Airlines Posts Profit Despite Terror Attacks' Impact", Wall Street Journal, October 26, 2001.

<sup>&</sup>lt;sup>272</sup> Jet Blue Airways also claims to have been in a stable position. Since the company is not required to report earnings as private company, it is not included in the discussion.

percent compared to the 71 percent industry average. Southwest's current market capitalization exceeds the value of all other major carriers combined. Due to the government aid plan, the carrier could post a \$ 151 million third quarter profit, yet claims that yields would have to increase 10-12 percent in order to remain profitable until year-end. Southwest has also been struck by low load factors, but until now it seems to have no plans to layoff employees. Continental Airlines laid-off 12,000 of its 56,000 employees almost immediately after September 11. This has led analysts to wonder what portion of financial difficulties can be attributed to the attacks.

Air Tran Holdings reported a \$10.6 million net third quarter loss as revenue declined 6.7% to \$150.7 million. The company received \$30.3 million from the U.S. government in emergency aid but wrote off \$28 million in the market value of its DC-9 fleet due to the after-effects of Sept. 11. Air Tran posted an operating profit of \$1.8 million and had \$135 million in cash as of Sept. 30, versus \$103 million as of Dec. 31, 2000. Passenger revenue per available seat mile plunged 14.3% to 8.89 cents from 10.37 cents.<sup>274</sup>

According to UBS Warburg, all major US carriers are likely to survive, although Airline stock prices on average have lost 40 percent from levels prior to attacks.<sup>275</sup> The trade of US Airways stocks was recently suspended. UBS Paine

<sup>&</sup>lt;sup>273</sup> "Short on frills, big on morale: South West Airlines" Financial Times, October 31, 2001.

<sup>&</sup>lt;sup>274</sup> Air Tran Loses \$10.6 Million, As Post 9/11 Revenues Plummet", Aviation Daily, November 2, 2001.

<sup>&</sup>lt;sup>275</sup> "Industry Net Loss This Year Pegged At \$5.6 billion", World Airline News, November 2001.

Webber estimates overall losses in the US airline industry to amount to \$ 6.4 billion in 2001 after taxes.<sup>276</sup>

In response to the high losses, US airlines have been seeking to reduce costs by canceling routes, reducing catering expenses, and tighten company budgets wherever possible. Especially IT budgets have been addressed by these initiatives.

Table 5: Airline financial overview, Q3 2001

Carrier	Net Income (in millions)	ASM (in millions)	RASM (in cents)	CASM (in cents)	LF (in percent)
Air Tran Holdings	-\$11	1,651	8.89	9.00	67.1%
Alaska Air Group	\$25	4,687	10.24	9.9	71.0%
America West	-\$32	6,695	7.15	8.66	74.0%
AMR Corp.	-\$414	38,929	8.84	11.21	72.3%
Continental	\$3	21,994	9.33	9.34	73.7%
Delta Airlines	-\$259	37,730	9.00	9.94	71.2%
Frontier	\$7	1,201	9.66	9.5	61.0%
Midwest Express	-\$3	482	10.50	12.6	58.9%
Northwest Airlines	\$19	26,018	9.18	9.54	75.8%
Southwest Airlines	\$151	16,291	8.20	7.62	69.1%
United Airlines	-\$1,159	43,022	9.52	11.27	73.1%
US Airways	-\$766	17,149	10.17	12.18	71.1%

Source: Plane Business, Q3 2001<sup>277</sup>

ASM: Available Seat Miles

RASM: Revenue per Available Seat Mile CASM: Cost per Available Seat Mile

LF: Load Factor (RSM/ASM)

www.planebusiness.com

<sup>&</sup>lt;sup>276</sup> UBS Paine Webber, Research Note, November 14, 2001.

# **D** Focus Group Interview

A focus group interview was conducted on February 28, 2002, among a group of 12 business students at Embry-Riddle Aeronautical University. The objective of the interview was to extract feed-back from a consumer point of view through a group discussion. The core of the discussion was the potential role of mobile technology in the travel process. Emphasis was put on mobile check-in and boarding, especially with respect to the technological platform to be employed for such application. Smartcard based and WAP based mobile check-in applications were explained to the group in a brief presentation as base for the further discussion.

Questions	Feed-Back		
What is your first impression?	<ul> <li>This is going to be big, especially after 9/11</li> <li>No benefit, self-service kiosk is enough</li> <li>Smartcard better suited for leisure travelers</li> </ul>		
What would you as a customer want to know in order to use mobile check-in/boarding applications?	<ul> <li>How much is the time saving?, Can waiting lines really be fully bypassed?</li> <li>How much do I have to pay in order to be able to participate?</li> <li>Is the system really reliable, is it secure?</li> </ul>		
Is there a difference in perceived privacy concerns between smartcards and mobile phones?	<ul> <li>No difference</li> <li>Cell phones can be easily traced, danger of data abuse</li> <li>Personal information (spending habits, location, etc.) is available to credit card companies anyways</li> </ul>		

What advantages/ disadvantages do you see with respect to the rivaling technologies?	<ul> <li>Change of reservation not possible with smart card</li> <li>No interaction, otherwise cell phone is required in addition</li> <li>Smartcard better because it can also be used for international travel, regardless of telecom standards</li> <li>Smartcard has no communication feature</li> <li>For frequent flyers, WAP better suited because of cellphone/PDA availability</li> <li>Smartcards preferable due to risk of mobile phones to be abused by spamming with sales alerts, advertising, etc.</li> <li>One smartcard for all, integration of check-in application into a soon common device.</li> <li>Smart card more handy, fits into wallet</li> <li>Mobile phone to become universal tool</li> <li>Smart Cards become legacy technology</li> <li>Government will require a device incorporating biometrics (National identity card). Government can require travelers to possess a smart card, but not a mobile phone.</li> <li>Smartcard only acceptable if the display offers the same informational capabilities as a mobile phone.</li> </ul>
Do visual attributes of smartcards create likes/dislikes?  (Smartcard as marketing tool)	<ul> <li>No importance</li> <li>Cost is decisive element, also for business travelers</li> <li>An attractive looking loyalty card has a positive effect, connects a "good feeling" to the device.</li> <li>Smartcards may create loyalty attributed by a feeling of belonging and importance</li> </ul>
Objections towards mobile check-in and boarding	<ul> <li>Traveler still has to go through the system</li> <li>Self-service kiosks already exist, no need for mobile application to bypass waiting lines</li> <li>Timesaving potential not important to leisure traveler</li> </ul>
What would an airline have to "tell" you in order to get you interested in a mobile applications?	<ul> <li>Technology can incorporate security issues</li> <li>I hate being at an airport, whatever reduces the time spent there will create value</li> <li>Both options should be offered, I would like to have the choice</li> </ul>
How much would you be willing to spend to use this application (WAP or Mobile)	<ul> <li>\$20/\$25 a year</li> <li>depends on ticket price</li> <li>5% of ticket price</li> <li>Don't know</li> <li>Nothing</li> </ul>

	<ul> <li>Wrong question, airlines should pay for it</li> <li>As a leisure traveler, I would choose the cheapest possibility to get from A to B, time is not a factor justifying higher price.</li> </ul>
What factors appear to be decisive to you in order to choose between smart card or WAP platform	<ul> <li>Government regulation will decide which platform to use</li> <li>How endurable is the smartcard compared to mobile phone, how long does it last?</li> <li>Cost of the device, leisure traveler will always opt for cheapest alternative</li> <li>Is WAP as reliable as a smartcard</li> <li>Reliability of WAP application</li> <li>What if there is no signal available, or gets lost on the way to the gate.</li> </ul>

# **Summary**

Most members of the focus group see mobile check-in and boarding applications to be promising, especially given the changing airport environment. Some respondents perceive mobile applications to lack the ability to add value as self-service kiosks already exist, and current mobile procedures are do not allow travelers to bypass security lines. For the future, all participants predicted that WAP applications will be more promising than smartcards; this however depends on the availability of capable mobile phones as the cost of acquiring a device appears to be a main limiting factor for adopting mobile applications. The majority of respondents suggest that they would opt for a platform that can also be used for all travel and non-travel related processes. If a single device becomes commonly available allowing integration of all processes, this would be preferred

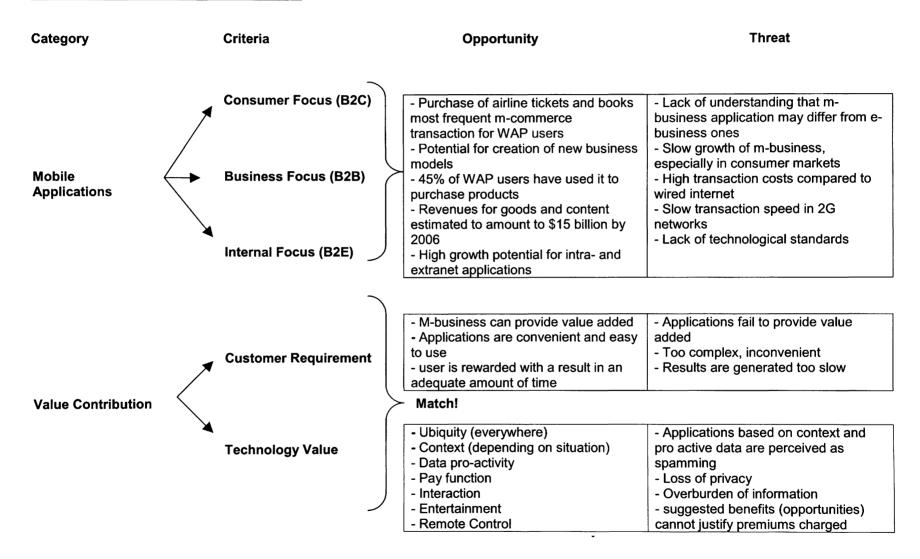
over having to use both technologies in the travel process. If they had a capable mobile phone available, all participants indicated to favor this as a technological platform due to availability of communication features. However, an overlooked aspect in the technological discussion may be the possibility to use a smartcard as a loyally marketing tool, especially if it is provided by an airline on a complementary basis.

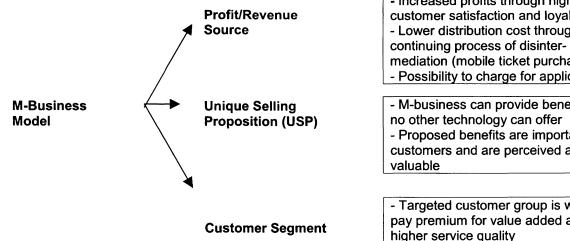
# **E** Results

The following section summarizes opportunities and threats for m-business to be used as strategic tool in the context of the US airline industry. Results are extracted from the environmental scanning analysis of the business environment in combination with conclusions drawn from the exploratory focus group interview.

## **Opportunities and Threats for Airline M-Business**

### **MOBILE BUSINESS ENVIRONMENT**



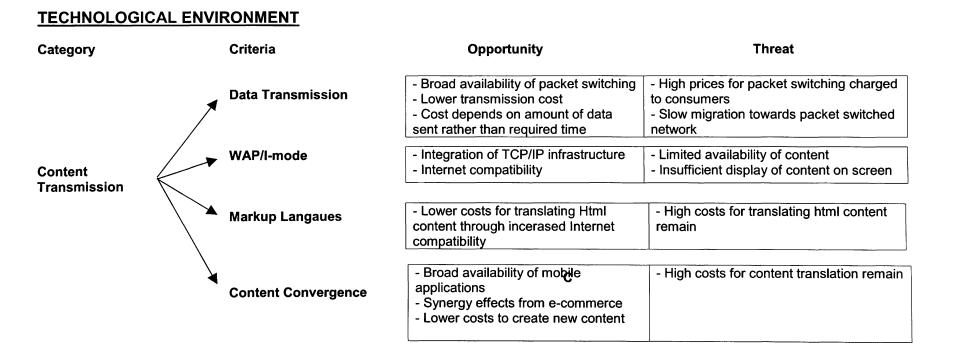


<ul> <li>Increased profits through higher customer satisfaction and loyalty</li> <li>Lower distribution cost through continuing process of disintermediation (mobile ticket purchase)</li> <li>Possibility to charge for application!</li> </ul>	Perceived increase in benefits is insufficient to justify prices charged     M-business forces customers into "false" loyalty     Lack of providing added value
<ul> <li>M-business can provide benefits that no other technology can offer</li> <li>Proposed benefits are important to customers and are perceived as valuable</li> </ul>	M-business fails to deliver the promised benefits     Selling proposition can also be accomplished through other means
- Targeted customer group is willing to pay premium for value added and	- Applications target the "wrong" group of customers

- Segment appreciates benefits

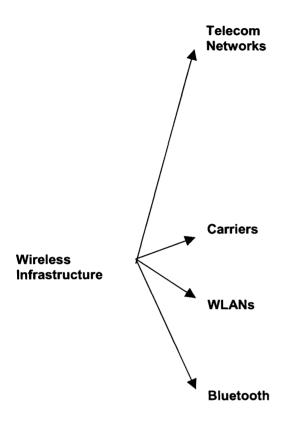
derived from m-business but is price

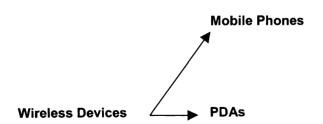
sensitive with respect to premiums



- Benefits offered by m-business are

perceived valuable in target segment





- Higher transmission rates (GPRS/CDMA95B)
- Compatibility between telecom vendors
- -Back- and forward compatibility between 2G, 2.5G, and 3G networks
- Compatibility between different air interfaces (GSM/TDMA/Cdma)
- significant improvement of geographical coverage, improved reliability

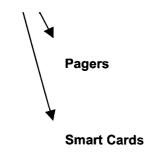
- Slow migration towards 2.5G and 3G networks
- Non-compatibility between vendors
- Non-compatibility between network generations (2G-3G)
   Non-compatibility between interfaces

Non-compatibility between interface: (GSM/TDMA/Cdma)

- lack of coverage, "holes" loss of coverage
- high cost to build up new networks
   (\$300 billion for all US carriers to roll out 3G) cannot be recuperated
- migration speed towards next generation networks
- possibilities to aquire new spectrum and 3G licenses
- high prices chaarged to consumers
- spectrum scarecity
- high cost from 3G licenses
- Pronunciation of common standards for 802.11b
- High speed (11Mbps)
- Possibility to substitute telecom networks in densely populated areas
- Interference, especially at airports
- Lack of data security
- Incompatibility due to lack of standardization
- Limited range (300 ft)
- Integration into standard software
- Ideal platform for "micro-payments"
- Faster than current telecom networks
- Lack of application
- High cost to build up network
- Limited range (30 ft)
- Back and forward compatibility
- Compatibility between interfaces
- Color screens
- Increased memory
- Integration of organizer capabilities
- Integration of Biometrics

- Not compatible between network generations
- Non-compatible between different interfaces
- Higher cost of 2.5G and 3G phones
- Boost of smart cards for biometrics
- Increase in memory (64 MB RAM)
- Increased networking capabilities
- Compatibility with standard software
- Migration towards PC capabilities
- Integration of Biometrics

- Only 2% of US travelers have PDAs equipped with wireless modem
- Slow economy decreases sales



- Increased memory (8 MB RAM)
- Integration of e-mail
- Compatible with telecom networks
- Obsolete as technology of mobile phones and PDAs advances
- Technological cannibalization
- Platform for "micro payments"/ virtual cash
- Proven capabil. for process automation
- Relatively inexpensive
- Loyalty effects/ good marketing tool

improvement with broad availability of

2.5G and 3G networks

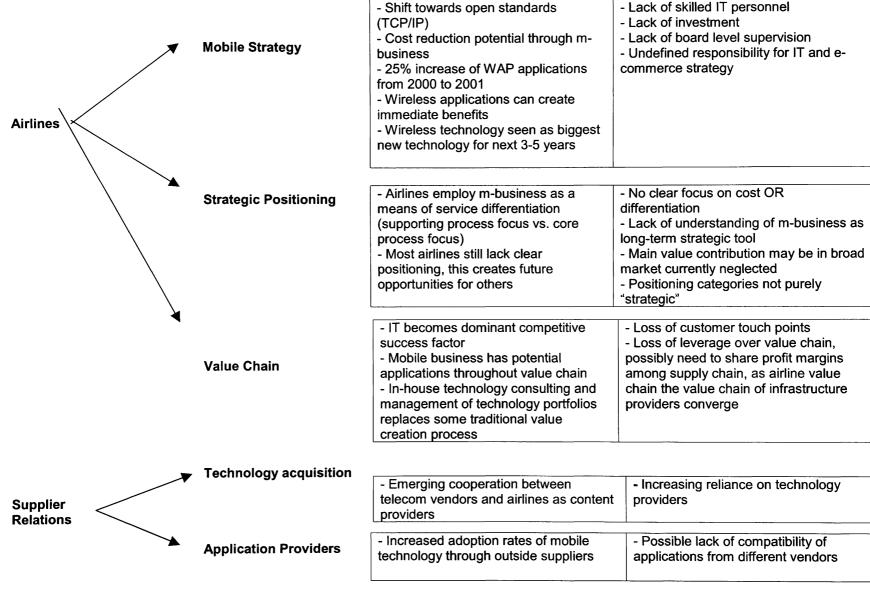
- Preferred device to incorporate **Biometrics** 

- Very limited range
- High cost of long range smartcards
- Not compatible with telecom infrastructure
- Obsolete technology in 3G environment
- Limited RAM for proximity cards (384Kb)

### **COMPETITIVE ENVIRONMENT**

**Opportunity Threat** Category Criteria - M-business creates "false loyalty - Increased loyalty and convenience - Cannot fulfill its promise (USP) either - M-business process exceed customer expectations in part or completely - M-Business can fulfill USP ("straight-- Innovation focus leaves customer **Customer Satisfaction** to-the-gate") needs out, lack of demand - M-business addresses latent needs - Increased satisfaction cannot be (mobility) measured - Shift towards digital technology for "active customers" Customers - Mobile innovations can create demand - Increased satisfaction is measurable - 21% of overall drivers of airline M-business lacks to address important customer satisfaction can be addressed satisfaction drivers Quality with current mobile applications - Great potential for quality

- Satisfaction drivers are addressed, but applications fail to deliver value added



US airlines are leader in IT spending
 Increased IT budgets since 1999

(2.4% to 2.8%)

- No increase for IT spending planned for

- Lack of common industry standards

2001/2002

# **SOCIAL/POLITICAL ENVIRONMENT**

Category	Criteria	Opportunity	Threat
Government	Airline Regulation	<ul> <li>Funding through Airport Security Bill</li> <li>Enhanced Airplane security program</li> <li>(\$500 million)</li> <li>Airport Improvement program</li> <li>Industry Aid Package</li> </ul>	Additional security screening at airports     Further restrictions to curb-site check-in
	Telecom Regulations	<ul> <li>- Auction of frequencies currently occupied by analog television</li> <li>- Release of spectrum for 3G (2500-2690 MHz) currently occupied by government organizations</li> <li>- Availability of 3G licenses from NextWave</li> </ul>	high bid prices at licenses auction that are difficult to recapture from revenues     Spectrum scarcity
Public ———	General	Mobile communication increasingly perceived to provide security     Security concerns increases willingness to pay premiums for related mobile initiatives	- Flying in general is perceived over- proportionally dangerous - Fear of additional terrorist attacks impacts demand for air travel
Industry and Associations	Biometrics	<ul> <li>Face-recognition, iris scanning, and hand geometry can help to cut general security lines, which in return "reestablishes" the selling proposition of process oriented applications</li> <li>Implementation of fingerprint imaging and voice biometrics has potential for creating an integrated check-in and boarding solution</li> <li>M-applications have potential to substitute passenger validation and authentication processes</li> <li>Public funding available for improvement of security standards on airline and airport side</li> </ul>	<ul> <li>Lack of biometric standards</li> <li>US airlines agree not to compete based on security</li> <li>Smartcards as only biometric technology platform make a fully integrated m-process solution impossible</li> <li>Deployment of biometrics needs to be undertaken as transnational initiative in order to be successful</li> <li>Risk of misusing biometrics as justification to discriminate against minority groups/foreigners</li> </ul>

### **ECONOMIC ENVIRONMENT**

Category Criteria **Opportunity** Threat - Strong US dollar exchange rate - Fear of recession **General Economy** - Increased public spending - GDP growth forecasted 1% for 2002, - Tax relief may offset some negative compared to 4.1% in 2000 - Record unemployment (4.5%) effects - High account deficit - personal consumption expenditure remains relatively high - Falling disposable income - Uncertainty in financial markets - Rapidly growing industry - Intensely competitive business **US Economy** Wireless Industry - Some major telecom providers report environment increased revenues despite slow - Industry losses due to "shaky" economy economy - Increasingly deregulated business - High costs to upgrade networks and environment for licenses - Bookings in leisure segment has - Net losses attributed to terrorist recovered significantly events estimated \$5.6 billion - 5% annual growth forecasted in air - Slow recovery of bookings in traffic till 2010 profitable business class segment **US Airline Industry** - Southwest Airlines and Alaska Airlines - Lower yields as average fares drop - Higher operating cost due to least impacted by industry crisis, carriers remain generally profitable insurance premiums - Realized need to rethink traditional - Labor disruptions, layoffs airline processes - Need of internal restructuring - Consolidation phase pre 9/11 may have created excess capacity - Cut down on IT budgets

### **Key Success Factors**

Key success factors of airline m-business are based on the essential requirements extracted from scanning the environment and from the focus group interview. In order to implement mobile applications as strategic tool successfully, these requirements in connection with forces in the business environment determine the key success factors, which have to create a strategic fit with mobile airline strategies.

Dominant forces stemming from the business environment consist of the most influential opportunities and threats. Most immediate opportunities are increased capabilities of the "Mobile Internet" to break compromises inherent in current airline processes, and the increasing availability of devices that are capable of executing wireless applications. These technological forces allow the possibility to expedite airport security lines through mobile applications, and availability of new business models, which may be used to differentiate airline service and generate a new stream of revenues. These opportunities are spurred by the increasing awareness of technology among the traveling public, especially since the September events.

Environment forces resulting from threats are the slow migration towards 2.5G telecom networks, and the still comparably low market penetration of mobile devices that can be used in a 2.5G environment. Also, the lack of identifying customer needs capable of being addressed by mobile applications threatens the possibility to create value for customers. Furthermore, strategic vision and understanding how mobile technology can be lead to a sustainable

competitive advantage imposes force in the competitive environment. Airlines simply seek to mobilize existing e-commerce processes, but fail to create new mobile business models, the same mistake many company's made when trying to implement e-commerce for their traditional business models. An additional competitive force is attributed to the existence of legacy IT infrastructure, making it impossible for airlines to integrate systems and to adopt standard Internet protocols and infrastructure (TCP/IP). An immediate threat originating from the social environment is the disruption of mobile check-in and boarding process chains. Another force from the social and political environment results from the necessity for certain mobile airline applications to be approved by the Transport Security Administration (TSA)<sup>278</sup>, as soon as security related aspects are tackled by m-business. These dominant environmental forces create the "rules" of the "mobile game", with which an airline's strategy has to comply. Generically, the key categories for success are found to be a pleasant user experience, the contribution of value through mobile technology, and fulfillment of customer requirements.

User experience relates to the way a user of mobile applications perceives mobile technology in terms of how convenient, fast, costly, and reliable it is to use. Success factors relating to the user experience are the requirement of mobile airline applications to be executed over the internet or at self service kiosks, the integration of all applications into as few different devices as possible, the possibility to yield results quick, possibly in less than 3 minutes, and reliability

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<sup>&</sup>lt;sup>278</sup> The TSA took over responsibility for airport/airline security from the FAA, please see section "social/political environment.

of applications, devices, and reception. This leads to the key success factor, to reward users with a fast result at low cost.

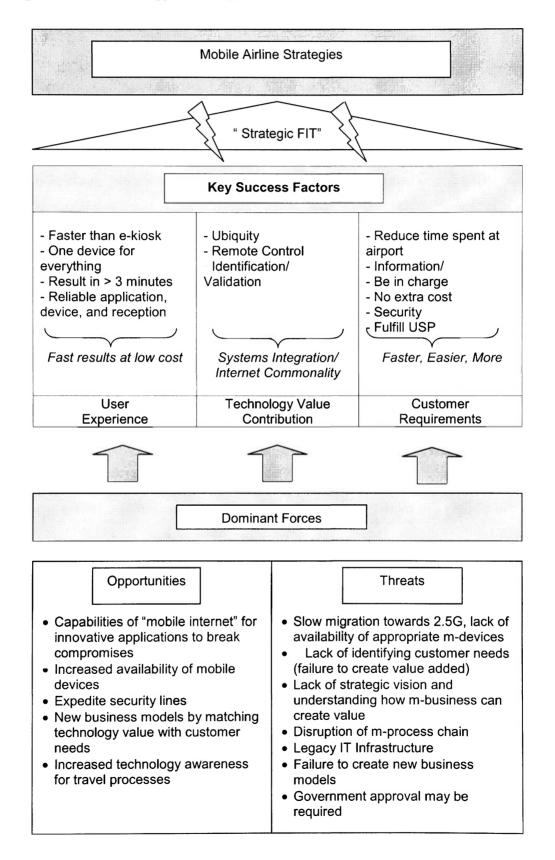
Technology value contribution describes the features of mobile technology that create value added to a customer. Success factors in terms of the technology value contribution are the possibility to execute applications everywhere (ubiquity), the possibility to initiate a process from a remote location (remote control) depending on location (context), and identification and validation features, which are necessary for all security related applications. The factor found to be key for providing technology value is the ability to integrate systems and to employ Internet compatible infrastructure.

Customer requirements constitute the lowest common denominator of mobile business characteristics customers demand. Most important elements are the requirement that mobile applications are capable of reducing the time spent at airports, provide information, and allow customer to be in charge of their surrounding. Furthermore, it is crucial that m-business applications fulfill their unique selling propositions. Applications are generally expected to be provided at no additional cost, and have to be secure in terms of data transmission, fraud, and privacy protection. Thus, the key success factor in this category can be described as "easier, faster, and more". Processes have to be expedited or facilitated, and more service has to be delivered in the same time.

Summarizing the above discussion, key success factors for m-business in the context of the US airline industry can be described in general terms as

delivering results quickly and at low cost, to integrate sub-systems and adopt internet infrastructure, and to provide "easier, faster, or more" services.

Figure 11: M-Strategy and Key Success Factors



### **F** Conclusion

All major US airlines have implemented mobile processes of some sort into their existing business models, and most airlines have embraced m-business as a means of service differentiation. Yet, today m-business is still viewed as a "nice-to-have" rather than as a strategic tool. From a positioning point of view, US Airlines do not show a clear strategy behind their mobile initiatives that would lead to a sustainable competitive advantage in terms of generic positioning strategies. Although one may lead to another, airlines should decide on a clear business approach whether to employ m-business as a cost saving tool, or as a tool to improve service quality. Following both approaches at the same time imposes the risk of not achieving either objective. Different approaches can be chosen for the supply side and for the demand side. It should be noted, however, that the focus on cost for demand-side applications encounters a main obstacle: the customer. M-Business may benefit from learning from the pitfalls of introducing self-service kiosks and e-tickets. If customer oriented applications lack to add value from a passenger point of view, or if the benefits of usage are improperly communicated to the passenger, these applications will fail.

Current mobile business models can be distinguished by taking into account the dimensions of scope (broad vs. narrow market segment) and process focus (core business processes vs. supporting processes). The dimension of scope, nevertheless, may be somewhat problematic. Most airlines identify the high-end customer segment to be the focus for mobile initiatives.

Given technological constraints and the availability of mobile devices, this appears plausible. However, these constraints will vanish as mobile technology advances. In the future, the main potential for airline M-business may be captured by the broad market of leisure travelers. This may also include a new stream of revenues by charging passengers in form of micro-payments for the use of mobile applications by partnering with wireless carriers. Investing in technology today that is limited to the high-end passenger segment and being limited to very specialized functions may prove to be a strategic mistake tomorrow.

"Tomorrow", m-business is likely to be part of nearly all value-creating activities throughout the value and supply chain. It will have a significant impact on the way an airline creates value to its customers. The number of touch points will be further reduced. Traditional key drivers of customer satisfaction, such as friendly airport or reservations staff shift over time, attributing more importance on how fast, comprehensive, and easy to use digital applications are. Thus, an airline's talent will be increasingly judged by how effectively it can integrate systems and adopt compatible IT infrastructure, as these are ultimate requirements for mobilizing services from the "offline" world. Future portfolios of mobile services will comprise of all current e-business activities, adding applications that are specific to the ubiquitous characteristic of wireless business. But it should also be noted that m-business is not for every body. There will always be customers who appreciate personal interaction, who are generally technology averse, or simply wish do "do things the way they have always done".

In order to define an adequate m-business strategy, three general approaches can be distinguished. One is to create value to customers by breaking compromises inherent in existing processes. A second approach is to address latent customer needs. And a third approach could be to pair core airline competencies with mobile opportunities. In either case, it is crucial to address the key success factors, which are to match the value mobile technology can contribute to customers and key requirements from a customer perspective. The third key factor, providing an enjoyable user experience, is greatly determined by the external technological environment. Until the wired internet and the mobile internet have completely converged, it appears unlikely that a single device will be capable of covering the entire spectrum of m-business opportunities for airlines. Thus, there is a trade-off between innovativeness in terms of mobile service offerings and integration of applications reducing the number of devices. Although existing wireless offerings may have contributed value in some way, attempts to add value through such services appears to have a rather coincidental character with respect to matching key factors. In addition, the great similarity of mobile services suggests a "copy cat" approach towards mobile strategy. If airlines intend to use m-business as a strategic tool, they need to have a precise understanding of which factors are important for providing technology value in particular to airline customers, and which are the minimum requirements passengers have to perceive value being added. Using this as a platform, airlines can begin to implement mobile features and services in a way

that has the potential of yielding sustainable differentiation with respect to service quality.

Besides the possible lack of customer focus, current mobile applications also reveal other flaws. The main threat of contemporary check-in and boarding application stems from the changing airport environment in response to September 11. At the moment, mobile applications tackling this area fail to deliver the promised benefits of being able to bypass waiting lines. In order to add value, m-processes have to yield an integrated solution incorporating biometrics, or security waiting lines have to be reduced by other means to the extend that they do not interrupt mobile processes. For this to be possible, common biometric standards have to be pronounced. Little advances have been realized as the industry anticipates government regulation, while the government expects industry initiative. Additional flaws result from the lack of strategic vision for information technology. Although airline IT departments have emphasized the need to integrate systems and migrate towards open standards and protocols, this vision has not fully evolved into business level strategies. Given the current financial instability of the airline industry, information technology, and as a consequence m-business, is regarded as a cost center rathre than as success factor. There are also internal discrepancies for m-business with respect to organizational functions and responsibility. Most airlines allocate m-business to their e-commerce departments. But responsibilities of e-commerce are not clearly defined. If airlines fail to develop an understanding of how e-business is

aligned with overall business and corporate strategy, the same flaws inherent in e-business will be imposed on m-business initiatives.

Only a couple of years ago, mobile business was believed to be technological revolution delivering quick profits with a scent of the gold rush era in the Wild West. Yet, after the burst of the "Internet Bubble", this has drastically changed as stock markets and investors returned to praising the "old economy". Companies have slashed IT budgets and many believe to have found the proof that the "new economy" has failed to deliver value in economic terms. Although this might be true to a certain extend, it should not be overlooked that mobile business has a great potential to offer benefits, in general and in an airline environment in particular. Learning from the traps of the Internet hype can present a great opportunity. Focusing carefully on what customers want and also are willing to pay for could be an essential driver for m-business.

The main constraints for current mobile airline applications result from the slow migration towards 2.5G networks, their exclusive availability in densely populated areas, and the relatively low penetration of WAP enabled cell phones in the US market. However, the infrastructure offering significantly more complex m-business applications is already in place. Although 2.5G networks still fall behind their promise to reach data speeds of up to 115 Kbps, this infrastructure provides an "always-on" function, which is key in the path of approaching capabilities of the wired Internet. Given the technological constraints, it appears plausible that some airlines find it unnecessary to offer mobile services to their customers at this time. But creating the required infrastructure takes time and

financial as well as human resources. Thus, today is the time when airlines have to develop a mobile strategy based on a clear understanding how mobile technology can create value, how this can address customer needs or core competencies, and how the use of mobile services should be communicated to customers. Reluctance to do so, or failure to identify the potential of m-business, may lead to a loss of opportunities in the future.

#### References

- ARINC (2001). Neutral Wireless LAN Architecture. ARINC, 2001
- AT&T. (2001). Wireless on Target to Deliver 3G Services. News Release July 17, 2001.
- Audia, Locke (2000). Successful Companies. Academy of Management Journal, Vol. 43, No. 5, 837-853
- Aviation Daily (2001). Air Tran Loses \$10.6 Million, As Post 9/11 Revenues Plummet". November 2, 2001.
- Banham, Russ (2001). Mad to Measure. eCFO Magazine, No. 12, Fall 2001, Vol. 17, 28-36.
- Battles Ahead in Volatile Market. Financial Times, Oct 17, 2001, 11.
- Battling for PDA market share. Wireless Week, Apr. 9, 2001, 20-21.
- Bell, M. (2001). Empowering IT leaders. Airline Business, October 2001, 95.
- Berthon, P., Hulbert, J.M., Pitt, L.F. (1999). "To Serve or Create? Strategic Orientations towards Customers and Innovation", California Management Review, Vol. 42, No. 1, Fall 1999.
- Best Western Sets Up Housekeeping on Wireless Web. CRMDaily, November 2, 2001.
- Bowen, B., Healy, D.E. (2001). The Quality Airline Rating. University of Nebraska.(www.unomaha.edu).
- Bresser, R, (2000). Strategische Managementtheorie, Berlin New York: DeGruyter, 18-38.
- Brwise, Patrick (2001). TV, PC, or Mobile? Future Media for Consumer e-Commerce. Business Strategy Review, 2001, vol. 12 iss. 1. 35-42.
- Bureau of Economic Analysis (BEA), New Release, October-November 2001.
- Canaday, H. (2001). Northwest Offers Choices for Simplification. Airlines International, September-October 2001, 45-47.

- Canaday, H. (2001). The Biometric Leap for Security. Airlines International, Nov-Dec 2001, 36-39.
- Canaday, H. (2001). A Question of Service. Airlines International, Vol.7, Iss.5, 28. October 2001.
- Charting Wireless Industry's Course after Sept.11. Wireless Data News, Potomac, October 10, 2001
- Cingular Tackels US Wireless Speed Barrier. Wireless Newsfactor, Oct. 31, 2001.
- Cingular Wireless to Deliver 2.5G Wireless Service to Consumers in the Southeast and Las Vegas. PR Newswire, Oct. 25, 2001.
- Clarke, R. (2001). Cutting IT can seriously damage your worth. Airlines International, November-December 2001, 60-61
- Conway, P. (2002). Lasting Impressions. Airline Business, Feb. 2002, 36.
- Delta To Begin Testing Enhanced Transponder, Cabin Video Surveillance Systems. Aviation Daily, Oct. 31, 2001.
- Demand for business flights "may halve" air travel. Financial Times, September 25, 2001.
- Department of Transportation (2001). Air Travel Consumer Report. DOT Office of Consumer Affairs, Washington D.C.
- Despaigna, P. (2001). Investors see vision of recovery. Financial Times, October 30, 2001.
- Dewar, H., Nakashima, E. (2001). Senate Split Delays Airport Security Bill. The Washington Post, Oct.4, 2001, 22.
- Dingley, D. (1998). Technology: Its effects on Travel Distribuiton and Service. In Handbook of Airline Marketing. New York: Mc Graw-Hill, 459-469.
- Doganis, R. (2001). Airlines International, Vol. 7, Iss. 3, May-June 2001.
- Dworlain, S. (2001). Security in the air industry. Airlines International, November-December 2001, 54-58
- Edmund, M. (2001). Airport Security: Eye-Catching Technology. Frequent Flyer Magazine, Dec. 2001.

- Ericson (2001). The TDMA operator path to GSM. Ericson White Paper, Sept 2001.
- Ericson (2001). The TDMA Operator Path to GSM. White Paper, September 2001.
- Excuse me, Your Handheld is Ringing. PC World, November 05, 2001.
- Flint, P. (2001). We are not waiting for a turnaround. Air Transport World, October 2001, 29-36.
- Forrester Group (2001). "The Cost Of Selling Online", The Forrester Report, July 2001.
- Frequent Flyer Magazine/J.D. Power and Associates (2000). Domestic Airline Frequent Flyer Customer Satisfaction Study- US Flights.
- GAMET (2001). Biometrics & Smart Cards: The future of airline security and passenger convenience. White Paper, September 2001.
- Geer, D. (2002). The E911 Dilemma. Wireless Business & Technology, Vol.1, Iss. 9, February 2002, 40-43.
- Global Economy to Grow 1.6 Pct in 2002: World Bank, Jiji Press English News Service, Nov. 1, 2001, Tokyo.
- Government rushes to put sky marshals on US jets", CNN.com, Sept. 22, 2001.
- GPS Cell Phone Alarms Pinpoint Emergencies. Wireless NewsFactor, September 25, 2001.
- Grounded Again. The Economist. Vo. 360, No. 8229, July 7<sup>th</sup>, 2001. 61-62.
- Heitmeyer, R. (2001). Face-the emerging biometric ID for MRTDs. Airport World, Vol. 5, Iss. 6, Dec-Jan 2000/2001, 49-53.
- Hide and Seek. Airline Business, October 2001, 36.
- Higgins, Kelly (2001). Northwest Plans for Wireless Curbside Check-in. Network Computing, March 3, 2001.
- Hirsch, L. (2001). Tiny Biometric Sensor offers Security on the Go. Wireless Newsfactor, Dec. 5, 2001.
- How to Measure, eCFO magazine, April 2001.

- IATA (2001). IATA traffic confirms effects on September 11", News Release, October 30, 2001.
- ICAO (2001). Meeting Caps most productive triennium in recent ICAO history. News Releases, October 5, 2001, Montreal.
- Industry Net Loss This Year Pegged At \$5.6 billion. World Airline News, November 2001.
- Insight on IATA. Airlines International, September-October 2001, 69.
- Insight on IATA. Airlines International, Vol. 7, Iss. 8, November-December 2001
- IT Survey Trends 2001. Airline Business. August 2001, 50-58.
- J.D. Power And Associates. Domestic Airline Frequent Flyer Customer Satisfaction Study, (1997-2000). <a href="http://www.jdpower.com/global/jdpaawards/releases/111400.asp">http://www.jdpower.com/global/jdpaawards/releases/111400.asp</a>
- J.D. Power and Associates, Yahoo!, Inc. (2001). Domestic Airport Passenger Satisfaction Study. Press Release, October 23, 2001.
- Jerney, J. (2001). L-Commerce: The good, the bad, and the ugly. Financial Times, September 18, 2001, Japan.
- Jones, T., Sasser, W.E. (1995). Why Satisfied Customers Defect. Harvard Business Review, Nov-Dec 1995, 88-99.
- Keen, N., Morris, P., Clark, P. (2001). Quality matters: service excellence in Airports. Airport World, December 2001, 35-37.
- Kotler, P., Bliemel. Marketing Management, 9. Edition, Schaeffer Poeschel, 1999, 496.
- Landcot, A., Swan, K.S. (2000). "Technology acquisition on an internationally competitive environment", Journal of International Management, Vol. 6, 2000, 187-215.
- Larson (2000). Marketing Management, Chicago, Vol.9, Iss.4, Winter 2000, 4-5.
- Laughlin, M. (2001). Sky marshals to fly again on jet liners. The Miami Harald, September 18, 2001.
- Lawmakers Push For Biometric Standard For Airport Security, Aviation Daily, Oct 31, 2001
- Leading the way to Wireless. Computer World, September 24, 2001.

- Leading the way to wireless. Computerworld, September 24, 2001.
- Looking for the pod of gold. The Economist, October 13., 2001.
- Louis ,P.J. (2000). M-Commerce Crash Course: The Technology and business of next generation Internet services, McGraw-Hill, 2000., 207-209.
- Low-fare exit for majors. Airline Business, November 2001.
- Maselli, J. (2001). "Coming to an airport near you", Information Week, Nov. 12, 2001
- Mason, K.J. (2001). Marketing low-cost airline service to business travelers. Journal of Air Transport Management, Vol. 7, 2001.
- Mc Donough, B. (2001). Nokia, Visa, Test New M-Commerce System. Wireless NewsFactor, September 2001.
- Mc Donough, M. (2001). US Slows Advance of High-Speed Wireless Services. Wireless NewsFactor, September 25, 2001.
- McDonough, B. (2001). Study: M-Commerce Faces Slow-Growth Future, Wireless NewsFactor, September 14, 2001.
- Melendez, E.M. (2001). "Wireless LANs", Passenger Terminal World, 2001, 144-147.
- Message to M-Marketers: Don't be Pushy. Wireless Newsfactor, September 18, 2001.
- Methner B., Rospenda, C.J. (2001). Airline Strategy in the Digital Age: What does "e" Mean to Me. In Handbook of Airline Strategy. Botler G., Keller, M.R., 1<sup>st</sup> edition, New York: McGraw-Hill, 389-406.
- Mineta vows better airport security". msnbc, Oct. 29, 2001 (www.msnbc.com)
- Mineta Speech, Airwise News, Sept 20, 2001.
- Mintzberg, H., Quinn, B. (1995). The Strategy Process: The Concepts, Context and Cases. Prentice Hall: New York, p.87
- Mital, V., Wagner, A., Kamakura, A. (2001). Satisfaction and Repurchase Behavior: Investigating the Moderating Effect of Customer Characteristics. Journal of Marketing Research, Feb. 2001, 131-142.

- Nelson, M.G. (2001). Plane Truths: American Goes Wireless. June 2001.
- Newton, G. (2001). The Universal Network. Airport World, Vol. 5, Iss. 6, December/January 2001, 43-46.
- NextWave Finalizes Agreement To Sell Its Spectrum Licenses. The Asian Wall Street Journal, November 5, 2001, Japan.
- Nokia and AT&T Wireless Services Complete First Live 3G EDGE Call. Business Wire, Nov. 1, 2001.
- Normire, D. (2001). Coming to America: I-Mode. Electronic Business, October 2001, 69-74.
- Norris, Mark (2001). Mobile IP Technology for M-Business, Artech House: London, 232.
- Northwest Airlines Posts Profit Despite Terror Attacks' Impact. Wall Street Journal, October 26, 2001.
- Northwest cuts back check-in time. Airwise News, November 6, 2001.
- Organized labor divided over airport security. CNN.com, Oct. 30, 2001.
- Oum, T. H., Yu, C (1997). Winning Airlines. Kluwer Academic Press, 1997, 5.
- Pfennig, A.(2001). "PDA Revenue to Increase Fivefold By 2006, Internet week, October 22, 2001, 39.
- Porter, M. E. (1985). Competitive Advantage: Creating and Sustaining Superior Performance. The Free Press, 1985.
- Porter, Michael E. (1996). What is Strategy. Harvard Business Review, November-December 1996. 61-78.
- Porter, Michael, E. (2001). Strategy and the Internet, Harvard Business Review, March 2001, 63.
- Proussaloglou, K., Koppelman, F.S. (1999). The choice of air carrier, flight, and fare class. Journal of Air Transport Management, Vol.5, 1999, 193-201.
- Raddan, A.B. (2001). Leading the way to Wireless, Computer World, Sept 24 2001
- Ramasami, V.C. (2000). "Advanced Mobile Phone Service- An Overview", University of Kansas, EECS Department.

- Report: Mobile Commerce Set for Growth Spurt, Wireless NewsFactor, October 31, 2001.
- Report: Mobile Commerce Set for Growth Spurt. Wireless NewsFactor, Oct. 31, 2001.
- Report: Profits won't keep pace with wireless explosion. Wireless NewsFactor, July 17, 2001.
- Rhodes, L. D., Waguespack, B. (2000). Service Quality in the US Airline Industry: Variations in Performance within Airlines and Between Airlines and the Industry. Journal of Air Transportation Worldewide, Vol.5, No.1, 2000, 60-77.
- Rhodes, L. D., Waguespack, B. (2001). Airline Quality: Present Challenges, Future Strategies. In Handbook of Airline Strategy. Botler, G, Keller, M.R. (Ed.), 1st edition, New York: Mc Graw-Hill, 469-477.
- Sabre, Motorola Team for Wireless Travel Service. DMNews, August 22, 20001.
- Salkever, A. (2001). The Price of Protecting the Airways. Business Week, December 2001.
- Sargan, N. (2001). Who is right about the US Economy. Financial Times, November 5, 2001.
- Saward, L.C. (2001(. Where is Wireless Going?, Airlines International, Vol. 7, Iss.2, March/April 2001, 49-52.
- Scourias, J. "Overview of the Global System for Mobile Communications, University of Waterloo.
- Service Quality Report Quantifies Travelers' Frustration with Airlines Passenger Turbulence. Omaha World-Herald, Omaha, Apr. 6th, 2001, 17-18.
- Sharkey, J. (2002). "Class Consciousness Comes to Airport Security", The New York Times, Jan 6, 2002.
- Short on frills, big on morale: South West Airlines. Financial Times, October 31, 2001.
- Smith, B. (2001). Airline Paging Service Flying High. Wireless Week, Feb. 14, 2001.
- Simon R. (2001). Congress Oks Airline Aid Package", L.A. Times, September 22, 2001.

- Simons, J. (2001). Greed meets Terror. Fortune Magazine, October 2001, 145-146.
- Slowotzky, A., Morrison, D. (2001). The Rise of the Active Customer. Marketing Management, Chicago, Vol. 10, Nbr.2, 2001, 22-26.
- Somogyi, Stephan (2001), "802.11 and Swiss Cheese", ZDNN, April 2001.
- Steinmann, Schreyoegg (2000). Management. Gabler, 5<sup>th</sup> edition, 163-163.
- Sullivan, J. (2001). Charting Wireless Industry's Course after Sept.11. Wireless Data News, Potomac, October 10, 2001
- Sweetman,B. (2001). "E-Commerce after Sept. 11", Air Transport World, Dec. 2001, 63-65.
- Taguchi, M. (2002). A mobile Internet Where the Customer is King?. Wireless Business & Technology, Vol.1, Iss. 9, February 2002, 30.
- Teach, E. (1997). How to succeed in IT. CFO Magazine, July 01, 1997
- Technology: Its Effect on Travel Distribution and Service. Handbook of Airline Marketing, 1998, 459.
- Thomson, A. A., Strickland, A.J. (2001). Crafting and Executing Strategy", New York: Mc Graw-Hill, 99-100.
- Top 50 companies. Smart Business Magazine, Sept 2001, 84
- Transatlantic Air Traffic down 36% after attacks. Financial Times. October 25.
- U.S. Sets Date for Wireless Spectrum Auction-Again. Wireless NewsFactor, Oct 17, 2001.
- UAL Posts Worst Loss Ever, Working To Stabilize Cash Burn. Aviation Daily, November, 2001.
- United Airlines Partners with Centerpost, Business Wire, August 6, 2001.
- United Introduces WAP Booking and Ticketing. Airwise News, November 2000.
- US Department of Commerce (2001). Gross Domestic Product: Third Quarter 2001., October 31, 2001.
- US Wireless Industry to Reach 60 percent penetration in five years. Wireless

- Today, Oct. 12, 2001.
- Verizon Sees Net Skid 46%, Cuts Forecasts. The Wall Street Journal, October 31, 2001. B6.
- Wall Street Journal. Airlines Traffic and Fares both fell during September, October 24, 2001.
- WAP Forum (2001). "WAP 2.0 Technical White Paper", The WAP Forum, August 2001.
- WAP vs. I-mode. Wireless Business & Technology, September 2001.
- Waters, R. (2001). Telecom Deals unlikely in the US. Financial Times, Oct. 26, 2001.
- Wayner, Gordon, A. (1999). The Future of Customers. Marketing Management, Chicago, Vol. 8, Iss. 3, Fall 1999, 8-10.
- Weick, K.B. (1995) Sensemaking in Organizations, Thousand Oaks, 1995.
- Why mobile is different. The Economist. October 13, 2001, 9-11.
- Wireless Internet Access at airports set to Take Off. Airwise News, September 19, 2001.
- With Airlines on Relief, The Feds Demand Data. Aviation Week & Space Technology, Oct. 8, 30.
- World Watch. The Wall Street Journal. Jun. 27, 2001, 8.
- Wrolstad, J, (2002). "Voice Recognition Employed for M-Commerce Security", WirelessNewsFactor, Feb. 1, 2002.
- Wrolstad, J. (2001). FCC Chief Calls for U.S. Spectrum Policy Overhaul", Wireless NewsFactor, October 24, 2001.
- Wrolstad, J. (2001). Palm Device Gives Public Safety a Hand", Wireless News Factor, Oct. 22, 2001.
- Wrolstad, J. (2001). U.S. Consumers Migrating Towards Broadband, Wireless. Wireless Newsfactor, September 19, 2001.
- Wrolstad, J. (2001). US Sets Date for Wireless Spectrum Auction-Again", Wireless NewsFactor, October 17, 2001.

Wireless wonders. Airport World, Vol. 6, Iss. 4, August/September 2001.

Wireless Landscape", New York Times, Oct. 8, 2001, C3.

Wireless Week. Airline Paging., Feb 2001, 14

Wittmer, K., (2001).Going Wireless? 5 Points to Guide You. Wireless Business & Technology, November 2001, 27-35.

Wireless NewsFactor. American Airlines Enlists Wireless for Schedule Changes, February 2001

Zagat (2001). Zagat Airline Quality Survey. Zagat, New York.

Zoebl, Joerg. (2001). Mobile Business und M-Commerce. Muenchen Wien: Hansa.