**CHAPTER TWO**

**LITERATURE REVIEW**

**Chapter Introduction**

In the arena of global competition, organizations all over the world are competing through the use of the most comprehensive and advanced technological features. The most common example of innovation is in the area of information technology and communication. Various industries are using technology and the advancements of software and internet to maintain and monitor their business transactions. In the application of the informative systems, the airline industry is the most commonly used system. This chapter explores the concept of reservation information system, their history, components, types and their applications in real world situation to solve problems.

**2.1 Brief History of Airline Reservation System**

The history of airline reservations systems began in the late 1950s when American airlines

required a system that would allow real-time access to flight details in all of its offices, and the integration and automation of its booking and ticketing processes. As a result, SABRE (Semi Automated Business Research Environment) was developed and launched in 1964. SABRE breakthrough was its ability to keep inventory correct in real time, accessible to agents around the world. Prior to this, manual systems required centralized reservation centers, groups of people in a room with the physical cards that represented inventory, in this case, seats on air planes (Ayeni, 2002).

The deregulation of the airline industry, in the Airline Deregulation Act, meant that airlines, which had previously operated under government-set fares ensuring airlines at least broke even, now needed to improve efficiency to compete in a free market. In this deregulated environment, airline reservation system (ARS) and its descendants became vital to the travel industry. In the early days of American commercial aviation, passengers were relatively few, and each airline's routes and fares were tightly regulated by the Civil Aeronautics Board. These were published in a volume entitled The Official Airline Guide, from which travel agents or consumers could construct an itinerary, then call or telex airline staff, which would mark the reservation on a card and file it. As demand for air travel increased and schedules grew more complex, this process became impractical. This system was used in the hospitality branch. (Wilson, 2008).

In 1946, American Airlines installed the first automated booking system, the experimental electromechanical Reservisor. A newer machine with temporary storage based on a magnetic drum, the Magnetronic Reservoir, soon followed. This system proved successful, and was soon being used by several airlines, as well as Sheraton Hotels and Goodyear for inventory control. It was seriously hampered by the need for local human operators to do the actual lookups; ticketing agents would have to call a booking office, whose operators would direct a small team operating the Reservisor and then read the results over the telephone. There was no way for agents to directly query the system. (Davies, 2004).

**2.2 Aviation Industry**

**2.2.1 Aviation Industry and ICT**

The use of Information Communication Technologies (ICTs) has changed the way how business are managed and dealt. The airline industry in particular has fostered a dependency on technology for their operational and strategic management. Airlines were early adopters of ICTs and have a long history of technological innovation, in comparison to many other travel and tourism businesses. Nowadays, many airline companies are shifting from their traditional way of communication with their customers to using modern technologies. Internet becomes a suitable place to reach out to many customers and potential customers in many businesses. The airline industry is one of them which uses the internet to market its services to a wide range of passengers around the world (E-Airlines, 2013).

**2.2.2 Influence of I.T on Aviation Industry**

Airline companies are implementing computerized systems in providing their services in which case all services that a person could possibly get by going to the airline ticket office, in person, can easily be accessed from his home, working place or any other place. Nowadays, airline reservation systems provide comprehensive and integrated modules from scheduling and reserving flights to revenue accounting on an internet based platform. This accessibility ease of service in turn contributes a lot in the cost minimization of providing services. (Wilson, 2008).

Just like any other service providing businesses, airlines also stand to gain enormous benefits from mobile devices in terms of operational, accessibility and service innovation. Increased passenger adoption of mobility, coupled with an array of applications and high-broadband capabilities, is creating new passenger touch points, experiences, and capabilities to deliver relevant and personalized services. Many airlines like American Airlines and Air France are going mobile to accommodate the growing trend of tech-savvy consumers and are expanding their mobile marketing strategy to retain customer loyalty. (Wilson, 2008).

The number of mobile subscribers in Nigeria has now reached over 90 million (Micheal et al., 2013); of these, 43.4 million mobile subscribers use the system to access internet service . This will open door to many businesses in our country to make their services accessible from mobile phones. The growth of mobility enabled applications is driven essentially by the same factors that are driving IT and business process change, namely the need to be more responsive, optimize the efficiency of staff resources, and shorten the cycle time of key processes throughout their value chain (Kevin, 2005). This growing trend of customers mobility has forced airline industries to shift from the traditional airline business models to customer mobility based models/service in order to exploit the growth of mobility, and many airlines are experimenting on providing mobility enabled personalized services for customers.

According to an annual survey on airline IT trends, co-conducted by SITA (Société Internationale de Télécommunications Aéronautiques), a global provider of aviation technologies and services leveraging consumer mobile technology remains the hotspot of IT investment. Offering mobile services to passengers has topped the investment list for the last three years with almost the entire industry now investing, or planning to invest, in this area, of which 86% of airlines will make a significant investment. Nine out of ten airlines are planning to sell tickets via mobile phones by 2020, establishing mobile as a mainstream distribution channel for airline tickets. Growing from zero just a few years ago, mobile phones as a distribution channel are expected to generate significant growth in years to come (SITA, 2017).

ITU (International Telecommunications Union) estimates that by the end of 2013, there will be around 6.8 billion mobile subscriptions globally, with that figure set to near the 7-billion mark in 2014 (ITU, 2013). Therefore, providing a mobile based service, not only in the airlines sector but also in any other service providing business, is of a vital importance to exploit the possible and available market and to win customer loyalty. In this very competitive industry, Nigerian Airlines can have enough ground to compete with other airlines and become competitive enough by making its services accessible from mobile. This proposed speech enabled mobile app for airline reservation will enable passengers to get the airlines reservation services through their mobile phone which is more convenient these days, which in turn enables the airlines to provide its services to mobile user passengers in more convenient and effective way.

**2.2.3 Airline Inventory Management**

An airline’s inventory contains all flights with their available seats. The inventory of an airline is generally divided into service classes (e.g. first, business or economy class) and up to 26 booking classes, for which different prices and booking conditions apply. (Winston and Morrison, 2005). Inventory data is imported and maintained through a schedule distribution system over standardized interfaces. One of the core functions of the inventory management is the inventory control. Inventory control steers how many seats are available in the different booking classes, by opening and closing individual booking classes for sale. In combination with the fares and booking conditions stored in the Fare Quote System the price for each sold seat is determined. In most cases inventory control has a real time interface to an airline’s Yield management system to support a permanent optimization of the offered booking classes in response to changes in demand or pricing strategies of a competitor. (Hens, 2006).

**2.3 Overview of Airline Reservation**

Today, air travel information is linked, stored, and retrieved by a network of Computer Reservations Systems (CRS), accessible by multiple airlines and travel agents. The global distribution system (GDS) makes for an even larger web of airline information, not only merging the buying and selling of tickets for multiple airlines, but also making the systems accessible to consumers directly. GDS portals and gateways on the Web allow consumers to purchase tickets directly, select seats, and even book hotels and rental cars. (Winston, Clifford 1995).

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Users access an airline’s inventory through an availability display. It contains all offered flights for a particular city-pair with their available seats in the different booking classes. This display contains flights, which are operated by the airline itself as well as code share flights which are operated in co-operation with another airline. If the city pair is not one on which the airline offers service it may display a connection using its' own flights or display the flights of other airlines. The availability of seats of other airlines is updated through standard industry interfaces. Depending on the type of co-operation it supports access to the last seat (Last Seat Availability) in real-time. Reservations for individual passengers or groups are stored in a so called Passenger Name Record (PNR). Among other data, the PNR contains personal information such as name, contact information or special services requests (SSRs) e.g. for a vegetarian meal, as well as the flights (segments) and issued tickets. Some reservation systems also allow to store customer data in profiles to avoid data re-entry each time a new reservation is made for a known passenger. In addition most systems have interfaces to CRM systems or customer loyalty applications (aka Frequent Traveler Systems). (Smith, 2002).

Before a flight departs the so-called Passenger Name List (PNL) is handed over to the Departure Control System that is used to check-in passengers and baggage. Reservation data such as the number of booked passengers and special service requests is also transferred to Flight Operations Systems, Crew Management and Catering Systems. Once a flight has departed the reservation system is updated with a list of the checked-in passengers (e.g. passengers who had a reservation but did not check in (No Shows) and passengers who checked in, but didn’t have a reservation. Finally data needed for revenue accounting and reporting is handed over to the administrative systems. (Olaniyan, 2005).

**2.4 Components of Reservation Information Systems**

There are complete Information Technology subsystems that make the reservation Information System operational; they are compatible in nature and the failure of one component may affect the operation of the others with in the system. They consist of computer resources, data, people, and procedures used in the modern business enterprise (O’Brien, 2001).

**2.4.1 Hardware**

O’Brien (2001) defines hardware as individual physical devices and material used in information processing. Specifically, it includes not only machines like computers but also data media i.e. all tangible objects on which data are recorded from sheets of paper to disc drives. Others include keyboards, mouse, printers, scanners etc.

**2.4.2 Software**

Rochester *et al.,* (2006) assert that software includes all sets of information processing instructions and it comprises of different types of programs that enable the hardware to carryout different tasks. Software is further categorized into system software and Applications software. System software is concerned with keeping the computer system working while Application software is the general purpose or written for a specific task like stock control. It may be written using a programming language or more general purpose piece of software such as database.

**2.4.3 Data**

Rochester *et al.,* (1996) [21], defines data as all raw and unprocessed facts that can readily be used. Cleary no database system can exist without data. The basic factor upon an organization’s processing and information needs are founded. Data elements and relationships must be precisely defined and the definitions must be accurately recorded in the data dictionary.

**2.4.4 People**

According to O’Brien (2001), these are required for the operation of all information systems. They include end-users and information system specialists. End-users are people who use an Information System. The reservation information system specialists help in the development and operation of information system. They include system analysts, programmers, computer operators and others. People, are probably the component that most influence the success or failure of information systems.

**2.4.5 Procedures**

These are set of instruction about how to combine the above components in order to process the information and generate the desired output. They consist of the way how to log on to the DBMS, use of different forms and manipulations throughout the project.

**2.4.6 Database**

Merril (2002) defines Database as a collection of non-redundant data, which can be shared by different application systems. Or database is a collection of data as well as programs required to manage that data. According to Merril, the importance of data has been obvious from time immemorial. Before the advent of computers, this was written in books or registers; these could be considered as ‘manual’ databases. Ever since computers were introduced as a means of sorting data, the concept and structure of a database have undergone a sea change. Database creation and maintenance is a gradual and continuous procedure being influenced by system software such as database management systems.

Database users state their requirements to the database using the data definition languages (DDL) and the data manipulation languages (DML) via the database management systems. The database management system surely provides an interface between the users programs and contents of the data base. During the creation and subsequent maintenance of the data base contents, the DDL and the DML are used for the following, add new files, expand the database, delete the absolute records, adjust data, and expand the database capacity, link up the data items and many others.

**2.5 Types of Reservations in Reservation System**

**2.5.1 Guaranteed Reservation**

This insures that the company will hold an item for the customer until a specific time following the customer’s scheduled date. In return, the customer shall guarantee his/her reservation of an item unless reservation is properly canceled. In order to guarantee a reservation, customers might opt for one of the following methods (Diane, 2003).

1. Prepayment guaranteed reservation
2. Credit card guaranteed reservation.
3. Advance deposit or partial payment
4. Travel agent guaranteed reservation

**2.5.2 Non-guaranteed Reservation**

This insures that the company agrees to hold an item for the customer until a stated reservation cancellation hour on that day. A reservation agent always makes sure to encourage their customers to guarantee their reservations especially in the high season. (Smith, 2002).

* 1. **Advantages of Reservation Information Systems**

**2.6.1 Convenience**

One advantage of booking a hotel, flight or car rental online is the convenience. Being able to make all your travel plans on the Internet means you can do it any time of the day or night at home, or while you are on your lunch break at the office. Customers on the go can even make reservations on their smartphones or tablets. There is no need for lengthy phone calls or visits to a travel agency, with just a few minutes and a click of the mouse, you will have all your plans finalized, Diane, (2003)

**2.6.2 Changes and Cancelations**

It is simple for travelers to change or cancel online reservations. Instead of calling the hotel or airline and waiting for a customer service representative to help you through the process, booking online means you can do it wherever you have Internet access.

**2.6.3 Customer Reviews**

Making a reservation over the phone or at a travel agency does not allow you to check out what past customers have thought of hotel chains or certain airlines. Another benefit of making online reservations is being able to see these customer reviews. Diane, (2003)

**2.7 Speech Recognition**

Speech recognition is the inter-disciplinary sub-field of computational linguistics that develops methodologies and technologies that enables the recognition and translation of spoken language into text by computers. Figure 2.1 shows the general architecture of speech recognition system. (Lee, 1988). The task of speech recognition is to convert speech into a sequence of words by a computer program. As the most natural communication modality for humans, the ultimate dream of speech recognition is to enable people to communicate more naturally and effectively. (Rabiner and Juang, 1993). While the long-term objective requires deep integration with many non-linear programme (NLP) components, there are many emerging applications that can be readily deployed with the core speech-recognition module we review in this chapter. Some of these typical applications include voice dialing, call routing, data entry and dictation, command and control, and computer-aided language learning (Lee et al., 1996). Most of these modern systems are typically based on statistic models such as hidden Markov models (HMMs) (Jurafsky and Martin, 2000). One reason why HMMs are popular is that their parameters can be estimated automatically from a large amount of data, and they are simple and computationally feasible (Jelinek, 1997). Speech recognition is often regarded as the front-end for many NLP components discussed in this book. In practice, the speech system typically uses context-free grammar (CFG) or statistic n-grams for the same reason that HMMs are used for acoustic modeling. (Gold and Morgan, 2000).

Modern speech-recognition systems have been built invariably based on statistical principles, as pioneered by the work of Baker (1975) and Jelinek (1976) and exposed in detail in Huang et al. (2001). A source channel mathematical model or a type of generative statistical model is often used to formulate speech recognition problems. As illustrated in Figure 2.2, the speaker’s mind decides the source word sequence W that is delivered through his or her text generator. The source is passed through a noisy communication channel that consists of the speaker’s vocal apparatus to produce the speech waveform and the speech signal-processing component of the speech recognizer. Finally, the speech decoder aims to decode the acoustic signal X into a word sequence Wˆ, which is in ideal cases close to the original word sequence W. A typical, practical speech-recognition system consists of basic components shown in the dotted box of Figure 2.2 Applications interface with the decoder to obtain recognition results that may be used to adapt other components in the system. (Huang et al., (2001).

There are two models in speech to text system, acoustic and language models; Acousticmodelsinclude the representation of knowledge about acoustics, phonetics, microphone and environment variability, gender and dialect differences among speakers, etc. Language modelsrefer to a system’s knowledge of what constitutes a possible word, what words are likely to co-occur, and in what sequence.

**2.7 Mobile phone Technology**

According to ITU the number of mobile phones worldwide outnumbered fixed-line phones for the first time in 2002 (Stallings, 2005). There are a number of reasons for the increasing dominance of mobile phones; importantly mobile phone is more convenient for users. Mobile phones come in different sizes some are incredibly small and some are considerably big and also the screen size, resolution, and color density varies greatly from device to device (Mehta, 2008). Usage of mobile phones for data communications is growing rapidly this is due to the improved network connections available for users that enabled them to use the internet through their mobile phone in addition to voice communication.

In the recent years, mobile phones have seen a number of innovations which has resulted in a vast variety of devices in the market from simple feature phones to smart phones. The mobile devices available in the market can be broken down in to a few broad classes (Cremin et al., 2007):

1. **Feature Phones**: These are the most common device type. Feature phones usually come in candy bar, clamshell or slider form. They have a 12-key layout and typically come with voice, messaging and data capabilities. They are typically targeted to the general consumer.

Smart Phones: Smart phones share the same features as a feature phone with two primary differences: Its ability to run additional third-party applications and a larger screen size. Smart phones typically use a more full featured operating system and they are marketed as advanced multimedia devices to consumers.

Speech recognizer

ˆ

W

Communication channel

X

Text

Generator

Speech

Generator

Signal

Processing

Speech

Decoder

W

Figure 2.1 General Architecture of speech recognition system (Lee, 1988)

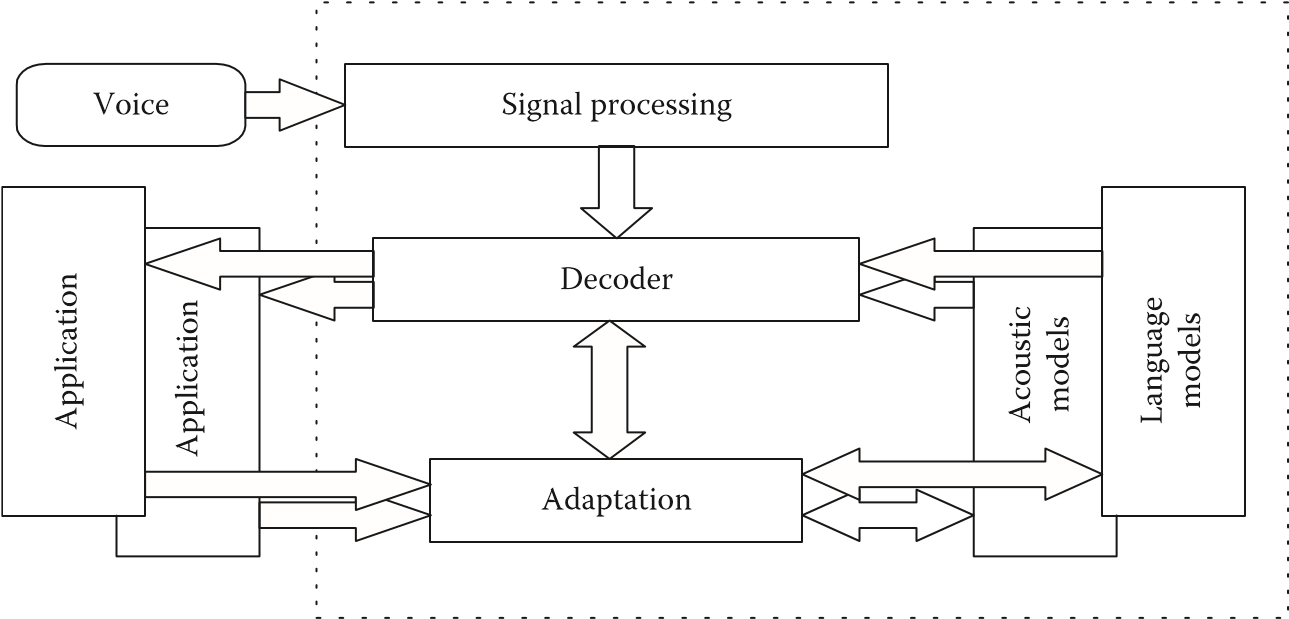


Figure 2.2A source-channel model for a typical speech-recognition system (Huang et al., (2001).

These devices typically include full office suites for documents and spreadsheets, spelling and grammatical applications. They also feature a full QWERTY keyboard that eases data entry, Global Positioning Systems (GPS) in which users can have access to location aware services, 3G connectivity.

1. PDAs: PDAs have much in common with the smart phone but differ in that much of their functionality is primarily oriented towards organizational tasks rather than voice communications. Another difference is that PDAs often include QWERTY keyboard and stylus in place of the 12-key layout on normal phones. They also feature a larger screen that can often switch between portrait and landscape mode.
2. Voice-Only Phones: These devices are typically extremely low-cost phones aimed at developing markets and are not relevant in the context of the mobile web.

**2.8 Wireless Communications**

The world of telecommunications is a vast and complex place, encompassing mobile, fixed, and internet connections. In past times, telecommunications and data communications were seen and treated as completely separate fields of technology. It is not possible today to talk of one and neglect the other; voice and data communications have converged in both mobile and fixed networks. The current generation of wireless devices is built using digital technology. Digital networks carry much more traffic and provide better reception and security than analog networks.

The standards that define how wireless communication devices interact are quickly converging and soon will allow the creation of a global wireless network that will deliver a wide variety of services. In addition to voice wireless communication enabled data communication in large scale trough a wireless internet. Wireless users internet experience is different from fixed users since wireless devices have limited displays and input capabilities compared with typical fixed devices such as the personal computer (Stallings, 2005).

Wireless network capabilities in mobile phones are the main enablers to invent new appealing applications. The wireless technologies available on most mobile phones differ in the supported data rates, the communication protocols used, the communication coverage, and the energy consumption related to it (Moll, 2016).

**2.9 Wireless Application Protocol (WAP) and Wireless Markup Language (WML)**

**2.9.1** **Wireless Application Protocol (WAP)**

The Wireless Application Protocol (WAP) is a universal, open standard developed by the WAP Forum to provide mobile users of wireless phones and other wireless terminals access to telephone and information services including the Internet and the Web, as such devices has limitations both on device wise and also on the network capability that connects them so WAP is designed considering the challenges related with wireless devices like limited processor and battery life and also imitations of wireless networks like low bandwidth and high latency as compared with wired connections (Stallings, 2005).

**2.9.2 Wireless Markup Language (WML)**

WML is designed to describe content and format for presenting data on devices with limited bandwidth, limited screen size, and limited user input capability. WML presents content suitable for wireless devices with small screen as well as large screen size and works with data entry mechanisms that are common to mobile and wireless communication (Stallings, 2005).

**2.6.3 Benefits of WAP/WML**

The following are some of the benefits of WAP/WML (Hatem et., 2010):

1. **Operators:** For Wireless network operators, WAP promises to decrease churn, cut costs, and increase the subscriber base both by improving existing services, such as interfaces to voice-mail and prepaid systems, and facilitating an unlimited range of new value-added services and applications, such as account management and billing inquires. New applications can be introduced quickly and easily without the need for additional infrastructure or modifications to the phone. This will allow operators to differentiate themselves from their competitors with new, customized information services. WAP is an interoperable framework, enabling the provision of end-to-end turnkey solutions that will create a lasting competitive advantage, build consumer loyalty, and increase revenues.
2. **Content Providers:** Some mobile applications are written in WML, which is a subset of extensible markup language (XML). WAP enables content and application developers to grasp the tag-based WML that pave the way for services to be written and deployed within an operator’s network quickly and easily. As WAP is a global and interoperable open standard, content providers have immediate access to a wealth of potential customers who seek such applications to enhance the service offerings given to their own existing and potential subscriber base. Mobile consumers are becoming keen to receive increased functionality and value-added from their mobile devices, and WAP opens the door to the untapped market.
3. **End Users:** End users of WAP benefit from easy, secure access to relevant Internet information and services such as unified messaging, banking and entertainment through their mobile devices. Intranet information such as corporate databases can also be accessed via WAP technology. Users are able to receive and request information in a controlled, fast and low-cost environment, a fact that renders WAP services more attractive to consumers who demand more value and functionality from their mobile terminals.

**2.10 Mobile Web Applications vs. Mobile Native Applications**

Mobile applications come in two distinct formats: native applications and web applications. Due to differences in their underlying technology, each approach has inherent advantages and drawbacks (Ellbäck, 2011).

**2.10.1 Mobile Web Applications**

Like a traditional web application, a mobile web application is built with three core technologies: HTML (defines static text and images), CSS (defines style and presentation), and JavaScript (defines interactions and animations). Since web applications are browser based, they are intended to be platform and device independent which are able to run on any web enabled phone. The key advantage of mobile web applications over native mobile applications is cross-platform compatibility, allowing them to reach the broadest audience. Web applications are also cheaper and easier to maintain than native applications for the reason they use a cross-platform technologies rather than dealing with the requirements of a specific types of devices (www.lionbridge.com, 2018).

**2.10.2 Mobile Native Applications**

A native mobile application is built specifically for a particular device and its operating system. Unlike a web application that is accessed over the internet, a native application is downloaded from a web store and installed on the device. Native applications have a major advantage over web applications the ability to provide functionalities for device specific hardware and software.

In contrast to their better functionality, for a native application to work across multiple devices, separate versions of the application are required and with the existence of wide variety of mobile devices this is very costly. (www.lionbridge.com, 2018).

**2.11 Web Services**

Web service is a set of standards and a programming methods for sharing data between different software applications, moreover web services is a standardized way to distribute services on the internet. A web service enables a platform independent service provision by providing well defined interfaces for distributed functionalities, which are independent of the hardware platform, the operating system, and the programming language. (Hatem et al., 2010)

This will be important for its success when we consider the fact that the mobile computing environment is much heterogeneous in terms of hardware platform, operating system, and programming language it requires a technology that connects mobile systems to a conventional distributed computing environment. Thus, the integration of mobile computing with web services technology will give many advantages as web services provide strong interoperable capability which is the key requirement of mobile computing technology (Abdaldhem et al., 2009).

**2.12 Related Work**

There are different airline companies which launched a mobile based reservation system. In most cases native applications are developed to support a specific type of a mobile phone device (Lock et al., 2010). The SOA based Web Services project is closely related to this project. It is a suite of powerful services that “VivaAir” offers to customers to benefit from its reusability (Chua, 2010). They adopt the SOA methodology (SOMA) from IBM and realize its applicability in the domain of airline reservation services. This project offers the following services:

* Customer Service: Which are used to manage customer profile.
* Flight Service: Which are used to get detailed information about flights.
* Reservation Service: Which are used to manage bookings.
* Payment Service: Which are used to acquire credit card information and deal

with payment. Though some of the services offered, in the above project, are not supported in this project, the concept, style and use of technologies are closely related.

Emirates Airline is driving online mobile innovation with a version of Emirates.com optimized for smart phones. Passengers who access Emirates.com from their smart phones are automatically redirected to the mobile website. The site is compatible with more than 3,000 devices, allowing passengers to interact with Emirates while on the move, from almost anywhere in the world ([www.emirates.com](http://www.emirates.com), 2018). The mobile site provides passengers with the flexibility to manage aspects of their journey. The popular features found on Emirates.com, including:

* Booking a flight and checking fares
* Checking in and choosing or changing seats
* Viewing passenger itinerary, requesting a meal, and booking ground transportation
* Checking real-time flight status and viewing global timetables
* Looking for products and services available on any specific flight
* Learning about dedicated departure lounges

The services offered in Emirates.com are identical to those of this project, it is just that those services are only accessible from smart phones using the web browser and not on speech enabled mobile android smart phones.