Article

Availability and Use of Information and Communication Technologies at an International Airport in Nigeria

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Abstract

In this paper, the availability and use of conventional and aviation-specific information and communication technologies by airport workers are examined. A sample survey research design and a purposive sampling technique were adopted. By using a questionnaire, quantitative data were collected from 213 staff of the airport, who were available during the survey and were willing to complete the instruments. Further, qualitative data were collected from two heads of departments by using an interview schedule. The conventional technologies of computers, printers, and photocopiers, among others, were reportedly available and used. Common-use terminal equipment and flight information display systems were reportedly the aviation-specific technologies known by the largest number of respondents (84% each), while the biometric identification system was known by the least number of respondents (43.6%). The respondents reported increasing use of these technologies in the last five years. The members of staff of the organisation have very fair opinions about their knowledge of the use and deployment of information and communication technologies, but they identified infrastructural constraints and the high cost of equipment maintenance as hitches to the adequate deployment of the ICTs. Continuous training—that covers both conventional ICT and aviation-specific information and communication technologies—is required to improve the performance of airport staff.

Keywords: information and communication technologies; Federal Airports Authority; Nigeria; international airport; aviation industry

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Introduction

Flying has become one of the most popular forms of public transportation, and it serves mainly the upper class of society who can afford the cost. Speed, efficiency, comfort and safety, which characterise modern society, are the hallmarks of air transport (Buhalis 2003; La, Bil and Heiets 2020; Kelemen 2002; Sarkar and Dutta 2020). Today, employers and employees of a business and government organisations as well as private individuals are able to reach most places in the world within hours. Operators in the industry, including airport authorities, realised fairly early the need for efficient, quick, inexpensive and accurate handling of aviation services (International Society of Aeronautic Telecommunication [SITA] 2002). As a result, airports around the world get flooded with passengers, making it imperative that information technologies are the only way that leads to a fruitful future in the aviation industry (Graham 2008; Monteiro and Macdonald 1966). As a result, they have been investing heavily in information and communication technologies since the 1950s (Centre for Asia Pacific Aviation [CAPA] 2009; Kelemen 2002; Singapore Airlines 2019).

The use of information and communication technologies (ICT) in aviation today covers all areas of activities in the industry, namely: air cargo automation, air traffic control, aircraft and crew management, airport and departure services, airport security, catering, finance and administration, flight operations, maintenance and engineering, marketing services, reservation and ticketing, and yield management, among others (Brennon 2008; International Air Transport Association [IATA] 2019). ICT and business applications are essential to airport operations, and advances in information and communication technology have significant implications for the maintenance, administration and effective operation of airports (Buhalis 1998; La et al. 2020). Airports and airlines all around the world encounter strong competition, and many countries increasingly look at airports as potential revenue-generating enterprises. The industry continues to experience a trend towards ICT as a means of unleashing new opportunities and enhancing passenger experience as well as attracting new investments and absorbing the pressure of making airports safe and secure, efficient, and economically viable.

In Nigeria, the Federal Airports Authority of Nigeria (FAAN) is the agency statutorily charged with developing and managing customer-centric airport facilities for safe, secure and efficient carriage of passengers and goods at world class standards. The removal of Nigeria from the list of countries whose airspaces are not safe by the United States, confirms the observations that FAAN is working hard to ensure that the Nigerian aviation sector competes favourably in the global aviation business. To underscore this, the airport employed the services of private companies to assist in providing world class information and communication technology and other airport infrastructure. The information technologies at the airport can be divided into two, namely, conventional information and communication technologies (such as computers, scanners,

photocopying machines and others) and aviation-specific information and communication technologies (such as common-use passenger processing systems).

However, the airports in Nigeria are known to suffer poor infrastructure, and there is strong evidence of inefficiencies resulting in poor passenger affairs and cargo management, customer dissatisfaction and low revenues, among others (Abubakar 2010; Ayodele 2010; Fortune 2007). There are problems regarding the security and safety of the airports in the country—a fear fuelled by a series of plane crashes in the last 10 years. There are usually delays in service discharges, leading to long queues, missing of flights and loss of baggage claims, among others, despite the overall traffic at the airport being below its installed capacity on an annual basis (Aisuebeogun 2009).

Objectives of the Study

This study was designed to examine the availability and use of conventional and aviation-specific information and communication technologies to workers in FAAN in Lagos, Nigeria. The study also examined whether the staff of FAAN knew about the existence and use of some aviation-specific information and communication technologies, and whether the technologies were also available at the airport.

Literature Review

Brief Overview of the Role of ICT in the Aviation Industry

Information and communication technology has been linked to the aviation industry as a key enabler for communications, business innovation and business models (CAPA 2009). In the 1940s, there were no international telecommunications networks in many parts of the world, so airlines set up their own private high frequency radio networks. Around the 1950s, the air transport industry started to handle messages using an international standard code, while the first fully-automated reservation system was introduced in the 1960s, which formed the backbone of the new SITA network. In the opinion of Francesco (2009) and Hoffman (2018), this set the stage for the worldwide integration of computers and telecommunications into the air transport industry and laid the groundwork for the essential role that information and communication technology (ICT) continues to play in the industry today. With the introduction of affordable, portable personal computers and the widespread adoption of the Internet, ICT has ushered in a new information age in aviation and it continues to serve as a powerful force for change, innovation and growth (Lang 2000). Beyond the introduction of personal computers, there has been a rapid development of information and communication technologies that are specifically used to manage aviation services (Hoffman 2018; O'Connor 2000).

Today, the aviation industry is advanced in the use of information and communication technology and a number of airline functions rely heavily on information and communication technology (Dimitrious 2004; Zaharia, Pavel, and Hirceag 2018). Aviation is the second most dependent industry on information and communication

technologies in the world, the first being the financial industry (Hopper 2000). Very significantly, airlines are quick to adopt new technologies to improve efficiencies that are expected to translate into cost savings. Even beyond cost savings, ICT is rapidly becoming a platform to generate new revenues and this represents a major paradigm shift from the traditional role and definition of ICT in the organisation.

Kelemen (2002) studied information and communication technology development in the airline industry and stated that vendor companies had developed an extensive range of solutions to improve passengers' journey, streamline and integrate airline and airport operations, track baggage and cargo, and ensure that the highest levels of maintenance and aircraft safety and security are effectively communicated. Kelemen added that ICT provides solutions at every step of a journey for passengers, from providing up-to-the-minute fare and flight information to safe arrival. Dimitrious (2004), in a study on the strategic and tactical use of ICT in the airline industry, reported that ICT had revolutionised the entire airline industry. The author demonstrated that the industry used the Internet heavily to improve its distribution strategy and reduce costs; it also used Intranets and internal systems to develop tactical and strategic management. Dimitrious (2004) further noted that extranets were being gradually used for communicating with partners and to support business-to-business relationships. In many cases, ICT is helping not only to provide solutions to infrastructure challenges and support issues in the aviation industry but also helping to shape the industry's future. ICT will remain critical to the strategic and operational management of airlines and will directly affect future competitiveness in the industry.

Zaharia and Pietreanu (2018) studied challenges faced by airports such as appropriate infrastructure for future resource management, allocation, and automated passenger flow forecast tools. They examined how airports focus on improving operations and innovation while enhancing passenger experience through the use of different concepts such as: airport collaborative decision making (ACDM), airport operations centre (APOC), and total airport management (TAM), which benefit from new technologies and digital tools. They examined airport digitisation trends, the structure through which total airport management is implemented, and identified the changes in airport management determined by new implementation schemes.

Specific Uses of ICT in Aviation

ICT is being used for different activities in the aviation industry. Most common is the deployment of conventional ICT in the area of administration helping airports to minimise costs, enhance the quality of service, improve profitability and ensure that passengers travelling through their airports enjoy a safe and efficient experience (Boutin et al. 2018; Davis and Pritchett 1999). Apart from the conventional technologies, there also exist aviation-specific information and communication technologies. New Information and Communication Technologies in Aviation (NITA),[1] an aviation service

1 See http://www.nita.ru/cgi/index.pl?lng=us.

provided by Equipment for Air Navigation System, has compiled a list of information and communication technologies that are specific to aviation, for example air traffic control (ATC), voice communications and recording systems, ground traffic surveillance, controller consoles and workstations, mobile control facilities and flight data processing systems for ATC. Other applications include airports and airlines briefing, information and data display systems, flight simulators and computer-based training systems.

A crucial development in the industry is the use of aviation-specific information and communication technologies to manage airport services. Very significant in this category is the air traffic control (ATC) and radio communications technology, which provide critical air-to-ground and ground-to-ground digital communications services. ATC directs aircraft movements via radio or other communications links. ICT used for departure services include common-use passenger processing systems (CUPPS), which make airline check-in applications fully portable, offering savings for airports and airlines. These systems enhance security by allowing airlines to share vital passenger and baggage information in real time on high-speed multi-user networks. Another airport technology is the baggage reconciliatory system, which reconciles the baggage of the passenger with the owner. This is also very similar to the passenger reconciliatory system that validates the authenticity of the bar codes on passenger tickets, as well as establishes links between the document reader and the airline. The system can also be used to track passenger movement after check-in, for example, determining whether they have enough time to clear security check-in to make their flight on time (Boutin et al. 2018; Dimitrious 2004; Guiu 2016).

A number of technologies are used to collect personal information during airport security screening**.** According to Patrick and Schmidt (2010), the identification of documents is used in combination with one or more databases, which might be owned and operated by the airline, the security agency doing the passenger screening, or other government agencies. Information from the documents is matched with database records to retrieve further information about the passenger, and this might include frequent flier account numbers, travel records, or assessments of security risks. The boarding cards given to the passengers also record some personal information, such as the name and travel itinerary. Special codes can also be printed on the boarding cards to relay information about security risk assessments to the security screening staff so that a passenger can be given more attention. Electronic boarding cards, sometimes stored on smartphones as two-dimensional bar codes, are starting to appear (Boutin et al. 2018; Guiu 2016).

Biometric information is sometimes collected during airport security screening. Frequent traveller programmes can allow people to use shorter security screening lines (Ingalls 2007). In order to qualify for such a programme, the traveller often has to provide biometric information, such as fingerprints and face images and detailed personal information that are all used during a background check. Some other

information and communication technology that is being used at the airport include X-ray scanners to examine carry-on luggage and also collect personal information related to the contents of the bags being scanned. One of the major information and communication technologies used in the flight operation services is the flight information display system (FIDS), which indicates which counters are allocated to each specific flight, the time of departure and the assigned boarding gate. To ensure that counters are easily identified, monitors are usually placed above all check-in counters, which indicate the flights currently checking in at any particular counter. A flight information display system is very important in any airport to keep passengers informed of their flight schedule and to make them aware of any delays (Boutin et al. 2018).

Several airports are using common-use terminal equipment (CUTE) check-in and boarding systems to facilitate passenger processing. They are also using baggage reconciliation systems and inline baggage screening systems to improve both the passenger and the airline experience at the airports (Francesco 2009). Most airports have installed an in-line baggage screening system to facilitate quicker processing of passengers' baggage. Some airports have also implemented baggage reconciliation systems and solutions (such as baggage tracers) to further improve both the passenger and airline customer experience at the airport (Zaharia et al. 2018).

According to IBM (2008), the innovation of self-service baggage checks is based on the assumption that passengers would be able to tag their own checked baggage. In the current two-step self-service check-in system, passengers obtain boarding passes via the Internet and then proceed to a bag drop position, where an airline agent prints the appropriate baggage tags and checks the passenger's identification (Murphy 2007. The passenger's checked baggage is tagged and placed on the baggage belt by the airline agent. In contrast, self-service baggage check, in combination with common-use technology, allows for a one-step system where passengers can obtain a boarding pass and tag their own bags in a single location. This method allows airline agents to focus on their full-service customers, for whom they can provide a higher level of service; roaming customer service agents could patrol the self-service areas and provide support as needed. Passengers who need assistance in the self-service area could be directed to a self-service "help" desk or the full-service counters. Avery (2008) observed that self-service gained tremendous momentum in the banking industry with automated teller machines. Self-service has become commonplace at airports throughout the world and has reduced passenger-processing times at a lower cost (Boutin et al. 2018; Guiu 2016).

Insights from some Technology Use Theories

Awareness and use are very common variables in the study of technology, and they are also elements of modern approaches used in examining technology use, such as the innovation adoption theory by Rogers (1983) and Davis's (1989) technology acceptance model. Many variants of these theories exist, as well as new and even older theories. A major tenet of all the theories is to provide an explanation of how technologies are introduced, how they diffuse, get accepted and adopted, and then used in a society.

These are more often than not explained using personal, technology, psychological and other variables. Personal variables relate to demographic data about individuals and organisations or any other subject of interest, while technology variables relate to how individuals assess the structure, function and performance of the technology in various terms, while psychological variables would relate to all the cognitive issues that may influence technology use.

One of the components of the innovation adoption theory is relative advantage, which is concerned with whether a technology is perceived as better than the innovation that existed before it, and this is a crucial factor in whether users will adopt a new technology or not (Rogers 1983). This component is measured in economic profitability terms, effect on the status of users, ease of use, convenience, and satisfaction among users. Generally, people who are planning to adopt new technology often want to understand whether the new idea is better than the old one. Technologies that are not easy to learn and use might not be adopted speedily. Learning new technologies could be challenging—requiring both time, some cost, and some adjustment on the part of the user. For busy and older persons, demographic and psychological factors might, therefore, make this element very important.

Related to relative advantage is whether the technology is complex (Rogers 1983). According to Rogers, adopters want to know whether the technology is difficult to understand and use. He also suggests that when a technology is considered complex to use, adoption of the technology will be hampered. Complexity often relates to whether users of the technology can freely operate the technology on their own and whether the presence of the technology poses security threats to the users. Complexity and relative advantage are related. For instance, a technology could be easy to use but also complex at the same time, while a technology that is difficult to use might not necessarily be complex.

Some empirical studies exist that have related relative advantage to the complexity of technology. In a meta-analysis of characteristics of innovation, Tornatzky and Klein (1982) found that relative advantage and complexity of technology were consistently related to decisions to use a technology or adopt an idea. Their findings agreed with Lampinen (n.d.), who found that relative advantage was one of the most important characteristics of innovations. Nysveen and Sendecka (2006) found, in their own study, that complexity was related to perceived ease of use, which is an element of relative advantage. Wei and Zhang (2008) added a third construct, which they called “other functionally similar new media technologies.” This was supported by Rogers (1995) in his concept of a technology cluster in which he suggested that the adoption of technology in a cluster may lead to the adoption of another technology in the same cluster. From this concept, the technologies people adopt could be useful in predicting the new technologies they would adopt. Those who are adept in the use of conventional information and communication technologies, for instance, might find it easy to adopt aviation information systems.

Peters (2007) shows that the psychological perspective in mobile communication technology is generally concerned with people's perceptions, expectations and attitudes. In their study of the adoption and use of mobile phones in rural China, Wei and Zhang (2008) classified psychological factors into perceived characteristics, perceived popularity and perceived need for mobile technologies. In several studies, personal and demographic information of people is also considered as psychological variables. Ahmad and Ahmad (2007) studied the influence of relative advantage in the acceptance of mobile technology in the Nigerian mobile market. According to Wei and Zhang (2008), perceived need assumes that users are likely to move from an old medium to a new one when they discover the old medium cannot meet some of their needs. In a very recent study among students in Nigeria, Nwagwu and Odetunmibi (2011) showed that ease of use and ease of availability had the highest mean scores among other components of relative advantage.

Wei and Zhang (2008) also identified two major components of technology complexity, namely perceived difficulty operating the technology and operating the technology on one's own. However, Odetunmibi (2010) found that age weakly explained the adoption of mobile phones with a negative and weak correlation, while males show a positive and significant slope. Goldstein and Kowalski (2009) have found a significant relationship between age and adoption of technology in Sweden. In a certain study, Wei and Zhang (2008) observed that the adopters of new technologies were younger and more educated persons who had higher incomes in comparison with others. Generally, many studies have shown that gender plays an important role in technology adoption (Gefen and Straub 1997; Morris and Venkatesh 2000).

In their research work, Goldstein and Kowalski (2009) also noticed a significant relationship between age and adoption of technology in Sweden. They observed that people below 30 years were over-represented in the early adopter segment. They, however, stated that according to Rogers (1995), no research clearly supports the theory that young people are earlier technology adopters than older persons. In another study, Tobbin and Adjei (2014) found that the adopters of new technologies tended to be younger, more educated, and have a higher income than others. Other studies have shown that gender plays an important role in technology adoption (Gefen and Straub 1997; Morris and Venkatesh 2000). It was discovered that people's decisions to use technology were more strongly influenced by their perception of usefulness (relative advantage), while women's decisions were based more on perceptions of the technology's ease of use (complexity). Meso, Musa and Mbarika (2005), in their study in sub-Saharan Africa, supported other researchers and stated that advanced education influenced an individual's capability to use a technology. In his own study, Peters (2007) noted that mobile communication technology behaviour was influenced by how people treat the technology and how well the technology was designed; people's social economic status and social background; the physical and virtual environment; as well as societal and macro-economic forces.

Several studies exist on the role of information technology and aviation; but there are no studies that have examined how technology use, adoption and acceptance theories could explain information and communication technology's role and development in aviation. Although this study was not strictly modelled after the traditional technology use and acceptance models, some of the variables in those models are considered very important in this present study, and were reviewed and deployed.

Methodology

Location, Population and Sampling

The study was carried out at the headquarters of the Federal Airport Authority of Nigeria (FAAN) located at the Murtala Mohammed Airport (MMIA), in Lagos Nigeria. MMIA is the flagship of Nigerian airports; the airport was built in 1979, four years after the first flight had landed in Kano. The target population was the staff of FAAN, and respondents were drawn from the two departments that are ICT intensive, namely the Departments of Security Services and Airport Operations. The total population in these two departments was 944. The study targeted a small sample size of 40% (n=378 respondents) of the population due to difficulties encountered in planning the study. The staff of these departments were not located in one office space where instruments could be administered to them; the security officials were distributed in various parts of the airport while the operations staff were often at the departure wings. Further, the study was guided by a mixture of qualitative and quantitative approaches, and only staff that were willing to participate in the study were surveyed.

Data Collection Instrument and Method

Two instruments were used to collect data for this study. The first was a questionnaire that contained questions on demographic characteristics including age, gender, position and working experiences. The questionnaire further asked the respondents whether they were familiar with conventional and aviation-specific information and communication technologies, as well as the use of the information systems. Also, the questionnaire addressed some of the technology adoption and acceptance variable, namely relative advantage and complexity. Finally, the questionnaire inquired about staff perception about the use of these technologies, and factors constraining the use of ICT.

In designing the questionnaire, the researchers relied on extensive preliminary formal and informal interactions with the staff of the organisation, particularly those who had the power to authorise the conduct of the study. The interactions with the key staff of the organisation during the questionnaire staff reduced the chances of invalid and unreliable questions, thus making a pre-test unnecessary. The interaction also ensured that the questions in the questionnaire and the interview schedule met the ethical expectations of the organisation, given the sensitivity of airports and the nature of the tasks they perform.

The next tool was an interview, administered to heads of the two departments, where the questionnaire was also administered. Basically, the approach was to focus the interview on salient issues that emerged from the questionnaire data as well as raise issues about the state of implementation of aviation-specific technologies that could arise from the questionnaire survey. The interview also sought to match the knowledge of the staff about the use and availability of aviation-specific information and communication technologies, with the information and communication technologies that were really on the ground.

Data Analysis

Data collected from the questionnaire were analysed using Statistical Package for the Social Science (SPSS), relying on non-parametric methods since the data did not meet the normality assumptions. The data were consciously described in relative detail before performing any cross-examination. The Mann Whitney test was used to establish the differences in the mean score for the use of aviation-specific information and conventional information and communication technologies by demographic characteristics of the respondents. In the same way, the Kendall Tau-b correlation was used to analyse the relationship between pairs of the aviation-specific technology variables: use, availability, awareness, and perceived challenges. The interviews were merely a follow-up of some of the responses in the questionnaire survey; the researchers just synthesised the result of the interviews and used them to support the discussion of findings from the questionnaire survey. Due to the difficulty of tracking the expected respondents, the interviews appeared scanty but provided insightful explanations that added value to the result of the study.

Results

Only 213 of the 378 anticipated respondents completed the questionnaire. Although this number is relatively small compared with the size of the workforce, 56% coverage is acceptable for an unsolicited survey, and given the difficulty experienced in administering the questionnaire. Table 1 shows that 33.3% of the respondents were males, 27.3% were females, and 39.4% did not supply their responses. The table shows further that the highest proportion of respondents, 27.2%, were in the age group 31–40 years, 25.8% in the age group 21–30 years, 9.9% in the age group 41–50 years, and 2.3% were above 50 years, while 34.7% of the respondents did not indicate their age group. The table also reveals that 35.2% of the respondents had 0–5 years' work experience in the aviation industry, 18.8% had 5–10 years, while the remaining 5.2% had 10–20 years' experience, and 40.8% did not indicate their work experiences.

Table 1: Demographic characteristics of the respondents

Characteristics	Frequency	%
Sex:		
Male	71	33.3
Female	58	27.3
No response	84	39.4
Age group:		
21–30	55	25.8
31–40	58	27.2
41–50	21	9.9
Above 50	5	2.3
No response	74	34.7
Working experience (years):		
0–5	75	35.2
5–10	40	18.8
10–20	11	5.2
No response	87	40.8

Awareness about the Availability of conventional ICT at the Airport

The survey inquired from the respondents whether they were aware of the availability of conventional information and communication technologies, namely: computers, printers, fax machines, microphones, document scanners, photocopiers, and digital cameras. All the staff (100%) reported awareness about the availability of computers, printers, and photocopiers; a negligible few reported not being aware of the presence of fax machines (2.1%), microphones (2.5%), and digital cameras (6.5%).

Use of conventional ICT at the Airport

Beyond availability, the survey also wanted to establish whether the staff knew how to use the technologies, as well as the extent of use, as shown in table 2.

Table 2: Use of the conventional technologies

Conventional ICT	Use %		How long using %			
	Yes	No	0–5	6–11	12–17	>17
Computers	99.1	0.9	34.8	20.0	21.4	23.8
Printers	99.1	0.9	35	23.3	22.3	19.4
Fax machine	84.2	15.8	38.3	10.9	22.3	28.6
Microphones	77.4	22.6	39	8.2	20.3	32.4
Scanners	95.7	4.3	36.5	22.8	25.4	15.6
Photocopiers	96.7	3.3	29.3	23.9	28.3	18.5
Digital camera	79.5	20.5	41.1	22.6	21.4	14.9

Traditional information and communication technologies of computers and printers were reported to be available and used by 99.1% of all the respondents. Nearly following the pattern of responses on availability, the use of microphones, digital cameras and fax machines was not known only to 22.6%, 20.5% and 15.8% of the respondents respectively, while just a few respondents, 3.3% and 4.3%, reported not knowing how to use photocopies and scanners.

On how long they had been using the technologies, the responses showed increasing use of the technologies in the last five years. Most outstanding was the use of digital cameras (41.1%). About 24% of the respondents who reported using photocopiers were the highest proportion of users of the conventional technologies in the last 6–10 years, while photocopiers were known by 28.3% of the respondents in the last 15 years. Beyond the last 15 years, the highest proportion of those who knew about the conventional technologies (32.4%) were those who knew about the microphone.

Awareness about Existence, Use of aviation-specific Technologies

Following this result on the availability and use of conventional information and communication technologies, the next survey asked a question about the availability of some aviation-specific information and communication technologies, and the results in table 3 show that the level of awareness in respect of their knowledge of these technologies among the staff, appeared to reduce. Table 3 shows that 94.7% of the respondents were aware of flight information display and air traffic control systems respectively, 91.9% knew about X-ray scanners and 90.8% knew about common-use terminals. The technology that enables passengers to check in themselves (CUSS) was reportedly known to 67.3% of staff. Also, biometric identification system, a security technology, and common-use passenger processing system, another self-check passenger technology, were known to 73.4% and 74.8% respectively.

Table 3: Awareness about existence of aviation-specific information and communication technologies

Airport specific equipment	**Yes**		**No**	
	Freq.	**%**	**Freq.**	**%**
Common-use terminal equipment (CUTE)	193	90.8	20	9.2
Air traffic control system (ATS)	202	94.7	11	5.3
Flight information display system (FIDS)	202	94.7	11	5.3
X-ray scanner	196	91.9	17	8.1
Baggage Reconciliatory system (BRS)	189	88.7	24	11.3
Common-use passenger processing system (CUPPS)	159	74.8	54	25.2
Biometric identification system	156	73.4	57	26.6
Common-use self-service (CUSS)	143	67.3	70	32.7

Availability and Use of aviation-specific Technologies

Having established whether the staff knew about the existence of these aviation-specific information and communication technologies, and how long they had known about these, the study examined whether the staff knew about the availability of the technologies at the airport. The results are shown in table 4.

Table 4: Availability of aviation-specific technologies

Airport specific equipment	**Availability %**		
	Yes	***No***	***Don't know***
Common-use terminal equipment (CUTE)	91.9	22.1	63.5
Common-use passenger processing system (CUPPS)	84.5	22.9	54.7
Common-use self-service (CUSS)	78.6	35.5	47.9
Baggage Reconciliatory system (BRS)	43.6	44.1	38.3
Biometric identification system	22.4	39.0	17.4
Air traffic control system (ATS)	17.6	5.0	1.5
X-ray scanner	16.6	8.1	0.0
Flight information display system (FDS)	14.4	21.4	0.0

Almost all the respondents reported that X-ray systems (91.9%) were available, more than eight of every 10 respondents (84.5%) reported the availability of air traffic control systems, while a little less than this number reported knowing that flight display information systems were available.

A closer examination of the results shows a rather high number of respondents who reported being ignorant about the availability of some major aviation-specific technologies. For instance, 63.5% did not know whether there was common-use terminal equipment (CUTE) or not, just as 54.7% did not know whether a common-use passenger processing system (CUPPS) was available or not. The proportion of staff (38.3%) who did not know whether baggage reconciliatory systems and biometric identification systems were available could also be considered relatively high, considering that these technologies are actually not very new and that a larger number of respondents had earlier reported knowing about their existence.

Regarding the use of aviation-specific technologies, 84.4% reported that they knew what the common-use terminal equipment is used for; much less than this (47.6%) knew about the use of common self-service. Knowledge of common-use passenger processing systems was reported only by 56.6%, but more respondents than this number (72.4%) reported knowing the use of a baggage reconciliatory system.

Table 5: Use of aviation-specific technologies

Airport specific equipment	Use %		How long known about %			
	Yes	*No*	*0–5*	*06–10*	*11–15*	*>15*
Common-use terminal equipment (CUTE)	84.4	15.6	38.5	48.1	8.9	5.7
Flight information display system (FIDS)	84.0	16.0	31.3	58.0	7.4	4.5
Baggage Reconciliatory system (BRS)	72.4	27.6	21.2	66.2	9.9	4
Air traffic control system (ATS)	68.6	31.4	26.8	10.1	8.7	1.3
X-ray scanner	58.7	41.3	58.3	29.4	10.8	0.0
Common-use passenger processing system (CUPPS)	56.6	43.4	52.7	23.7	17.1	7.8
Common-use self-service (CUSS)	47.6	52.4	49.9	23.4	18.8	9.4
Biometric identification system	43.6	56.4	53.8	32.8	7.5	7.5

Many people (84%) also knew about the use of flight information display systems, but the biometric identification system was reportedly known only to 43.6%. The proportion of people who knew about the use of X-ray scanners and aircraft control systems, was also relatively small; 58.7% and 68.60%, respectively.

The largest proportion of respondents that reported knowing about the use of aviation information and communication technologies in the last five years, knew about X-ray scanners (58.3%), followed by those who knew about biometric identification systems (53.8%). The least number of people reported knowing about baggage reconciliatory systems during the same period. In the last 10 years, the baggage reconciliatory system was known by the highest number of respondents (66.2%), while the least (10.1%) knew about air traffic control systems. During the last 15 years, less than 10% of the respondents knew about the technologies, except for common-use self-service, reportedly known by 18.8% and 10.8% who knew about X-ray scanners. As would be expected, most of the aviation-specific technologies were not known to many of the respondents; less than 10% reported knowing any of the technologies.

Perceptions of the Role of ICT by Airport Authority Staff

It was necessary to understand how the staff of the organisation perceived the use of information and communication technology at the airport, a result shown in table 6. More than half of the respondents (84.8%) agreed that information and communication technology was better than manual approaches. More than half of the respondents (59.4%) strongly agreed that passengers were satisfied with the implementation of information and communication technologies in the industry, while 39% of staff observed strongly that passengers did not want the X-ray machine.

Furthermore, 71.2% strongly agreed that the CUTE system of checking in was better than the manual system, but the proportion of respondents that strongly suggested that a baggage reconciliatory system was not necessary (22.3%) could also be considered

significant, given the advantages of the technology. Also, it is amazing that as high as 63.1% of the respondents could strongly agree that a microphone is better than the flight information display system. This could probably be associated with the opinion on whether the display system is easy to understand or not, in which case, 60.7% suggested strongly that the technology was difficult to understand. Amazing also is the strong opinion of 38.4% of the respondents that CUSS has the capability of reducing the delay of passengers; the particular challenge it was envisaged to ameliorate. Altogether, 87.3% of the respondents who reported that information and communication technologies had improved the service performance of the airport, showed that the staff of the airport authority had an overall fair assessment of the role of information and communication technology in their organisation.

Table 6: Perception about the role of ICT (%)

Perceptions	***SD***	***D***	***DK***	***A***	***SA***
Using information and communication technologies is better than manual approaches	6.2	4.7	4.3	21.8	63.0
Passengers are satisfied using the information and communication technology	10.0	11.0	19.6	34.0	25.4
Passengers do not want to use X-ray scanners	6.7	15.8	37.8	27.8	12.0
CUTE system of checking in is better than manual	7.7	3.3	17.7	36.8	34.4
Baggage reconciliatory system is not necessary for locating luggage	19.8	38.1	19.8	13.4	8.9
Using microphone is more effective than FIDS	14.4	16.3	6.2	19.6	43.5
FIDS is difficult to understand	13.7	30.7	3.9	23.9	27.8
CUSS reduces delay of passengers	8.7	9.7	43.1	25.6	12.8
ICT has increased service performance of the airport	5.4	3.4	3.9	20.1	67.2

Key: SD= Strongly disagree; D=Disagree; DK=Don't know; A= Agree; SA=Strongly agree

Perceived Challenges Faced by the Airport Authorities in Using ICT

Based on the experiences of the staff of the authority, the survey further inquired about their opinions regarding any possible challenges the authority faced regarding implementing information and communication technologies at the authority. Table 7 shows that the cost of staff training and the regular breakdown of the system were considered very serious by 53.4% of the respondents respectively, while 46.84% suggested that their staff were handling the equipment improperly. For 32.4% and 60.0% of the respondents respectively, the fear that the technologies might take their jobs and the high cost of replacing the equipment were major constraints, while the poor power situation in Nigeria was a major constraint to 80.2% of the respondents.

Table 7: Challenges faced by airport authority

Challenges of ICT use	Responses %				
	Very serious	**Somewhat serious**	**Not sure**	**Not serious**	**Not very serious**
Cost of training staff	53.4	24.5	7.4	5.9	8.8
Constant breakdown of information system	53.4	29.6	5.3	5.3	6.3
Improper handling of ICT by staff	46.8	37.6	4.4	9.8	1.5
Staff fear of being replaced	32.4	39.2	11.8	6.4	10.3
High cost of purchasing information system	60.0	19.0	9.3	8.8	2.9
High cost of maintaining information system	61.9	22.8	6.9	6.9	1.5
Electricity hinders operations	80.2	4.8	5.8	5.3	3.9

Further Statistical Analysis

The researchers compared the frequency of use of conventional and aviation ICTs to the demographic characteristics of the respondents. Using the Mann Whitney test, the objective was to establish the difference in the mean scores of reported use of conventional and aviation information and communication technologies by age, sex and length of employment of the respondents. Further, the Kendall Tau correlation was used to establish the relationship between pairs of use, availability, awareness and perceived challenges about aviation-specific information and communication technologies variables.

Mann Whitney test of differences in the use of conventional and aviation-specific information and communication technologies by demographic characteristics of respondents

This analysis was used to establish whether there was a difference between the use of conventional and aviation-specific technologies by the demographic characteristics of the respondents (see table 8). The table shows that there is a significant difference between males' use of the different technologies. With a mean score M=5.3, SD=1.3 for the use of aviation ICT and M=1.7, SD=0.22 for the use of conventional ICT, males reported using aviation information and communication technologies more than they did conventional ICT. However, females reported using conventional ICT (M=4.5, SD=1.2) more than they reported using aviation information and communication technologies (M=2.3, SD=1.8). The table shows further that there was no significant difference between reported uses of the technologies by those respondents who did not supply their gender.

Table 8: Relationship between demographic characteristics, use of conventional and aviation ICT

Characteristics	Use of ICT (Yes)	Use of Aviation ICT (Yes)	Z	P	Sig.
	Mean ± SD				
Sex:					
Male	1.7±0.22	5.3±1.31	-1.25	0.03	S
Female	4.5±1.21	2.3±1.82	-2.23	0.01	S
No response	0.9±0.14	1.4±0.93	-1.29	0.40	NS
Age group:					
<30	5.0±2.20	1.8±0.24	-1.15	0.07	S
31-40	2.8±0.24	8.9±0.23	-1.23	0.12	S
41-50	6.1±2.32	5.1±0.00	1.15	0.33	NS
Above 50	5.3±0.91	6.2±0.03	-2.13	0.11	NS
No response	4.4±1.28	4.2±1.02	-1.09	0.21	NS
Working experience (years)					
0-5	2.5±0.17	2.2±0.01	-1.23	0.98	NS
5-10	9.9±0.03	1.8±0.51	-1.13	0.07	S
10-20	1.1±0.14	0.2±0.05	-1.15	0.32	NS
No response	1.1±2.29	0.8±0.21	-1.03	0.09	NS

Note: At 5% level of significance: S=significant; NS= not significant

By age groups, significant differences were also obtained regarding the use of conventional ICT and aviation-specific ICT. An example of this difference was found among those respondents who were younger than 30, and, those between 31 and 40 years. Those aged younger than 30 years reported using conventional ICT (M=5.0, SD=2.2) more than they did aviation ICT (M=1.8, SD=0.2). However, this pattern of difference is reversed for those aged 31–40 who reported use of aviation ICT (M=5.9, SD =0.2) more than they did conventional ICT (M=2.8, SD=0.2). There was no significant difference for other age groups.

Finally, working experience also presented an interesting result. There existed a significant difference only among those who had worked for less than five years, who reported using conventional technologies (M=5.5, SD=0.1) more than they did aviation-specific technologies (M=2.2, SD=0.0). There also existed a significant difference among those who had worked for 5–10 years.

Relative Advantage and Complexity of Aviation IS

Relative advantage was measured by the respondents' opinions about whether the technology was relatively easy to use, convenient, cheap, safe, and if they were satisfied with the technology. Since the variables were measured on an ordinal scale, means were considered appropriate to gauge the magnitude of the opinions regarding aviation information systems and conventional ICT. As probably would have been expected,

table 9 shows that the respondents reported the conventional technologies to be by far easier to use than the aviation-specific technologies. The same pattern of results applies to whether the technologies were considered cheap, and, safe, and so forth.

Table 9: Mean scores of relative advantage and complexity of aviation IS

Relative Advantage	**Conventional**	**Aviation IS**
Easy to use	4.1	2.3
Cheap	3.5	2.8
Safe	3.3.	2.5
Satisfied using	3.9	2.3
Convenient	3.1	2.9
Complexity		
I operate the technology on my own	4.4	1.8
Difficult to operate the technology	1.9	4.7

The pattern of responses reverses with respect to complexity, with a lower mean score for self-operation of aviation-specific technologies and a high score for the perceived difficulty of operation of the technologies.

Using the compute command, the categories of relative advantage and complexity respectively were computed, and the nature of the relationship was sought between the resulting variables and use. Use and relative advantage are positively and significantly correlated (r=0.32, p=0.02); however, there exists a negative but negligible significant correlation between use and complexity (r=0.16, p=0.003).

Relationship between Pairs of Use, Availability, Awareness and Perceived Challenges

The researchers used the Kendall Tau-b correlation technique to address the relationship between pairs of use, availability, awareness and perceived challenges. The result showed that at 0.05 significance level, use frequency (M=19.83, SD=5.10) and accessibility (M=8.23, SD=1.25) had no statistically significant correlation (tau-b=0.39, p=0.89). It was also found that use frequency (M=9.22, SD=15.22) and accessibility (M=3.88, SD=0.11) did not have a significant relationship (tau-b = 0.19, p=0.23). The result was different for the relationship between availability and awareness about the existence of the technologies, which showed that awareness (M=12.12, SD=0.32) and accessibility (M=3.21, SD=0.36) had a significant correlation (tau-b= 0.51, p=0.003). In the same way, there was a statistically significant relationship between use of the aviation information and communication technologies and the challenges respondents reportedly faced in using in the sector (tau-b=0.56, p=0.001), with use (M=0.99.02, SD=1.76) and challenges (M=1.10, SD=2.02). Another interesting but contrasting result was that the relationship between awareness about the existence of aviation information and communication technologies (M=23.01, SD=11.16) and the challenges reportedly

experienced by the respondents in using the technologies (M=7.67, SD=0.02) was not significant (tau-b=0.49, p =0.20). However, the relationship between perceived availability (M=0.89, SD=0.09) of the technologies and challenges reported by the respondents (M=0.69, SD=0.12) was significant (tau-b=0.79, p=0.000).

Discussion of findings

Outstanding in the demographic information is the high proportion of non-responses, which did not repeat in other sections of the questionnaire; a challenge that probably symbolises the unwillingness of the staff to participate in the survey. Most of the staff (33.3%) in the two departments studied were young males, and 35.2% were employed in the last five years. This result tallies with evidence of rapid human and infrastructural turnover and changes occurring in FAAN in recent years. Supporting the foregoing, and probably indicating that only a few staff members have survived the reorganisation process in the agency, is the finding that very few staff had spent more than 10 years there. The result showed that the availability of conventional information and communication technologies was common knowledge among the respondents. All the staff were aware of their availability, but the awareness about the existence of aviation-specific information and communication technologies was relatively lower. As probably in other parts of the world, however, fewer staff members knew about the use of self-service and biometric information capture technologies—technologies whose awareness and knowledge of use were lower in our sample than the other aviation-specific information and communication technologies.

The study showed that knowledge of the respondents about the use of the conventional and aviation-specific information and communication technologies differed. Computers, printers, scanners and photocopiers, which commanded a high level of awareness among the respondents, could be considered commonly used technologies for administrative and related purposes in the organisation. Notably, the security and operations staff of FAAN expressed near ignorance about whether aviation-specific information and communication technologies were available in the organisation, despite the large number of staff members who were knowledgeable about their use and existence. It would appear that self-service in those technologies such as CUSS, CUPPS, CUTE and BRS recorded low numbers of respondents who were aware of the existence, use and availability of the technologies.

Issues about the low level of knowledge about the availability and deployment of aviation-specific information and communication technologies were raised in the interviews. The operations services staff informed the researchers that many of the aviation-specific technologies were actually either already acquired but not installed, or installed and not being used, or were being installed at that stage. For instance, the researchers were informed that FAAN was implementing electronic point-of-sale systems (E-POS) to streamline the commercial revenue streams and improve the efficiency of logistics support, finance and accounting. According to respondents, FAAN was also planning to leverage the investments it had made in self-service kiosks

by extending its capabilities to include passport scanning and baggage tag printing in all airports of the country. The organisation had already invested in state-of-the-art digital flight information display systems, offering real-time precise information displays to enhance the passenger experience at the airport. FAAN was also planning to provide kiosks for loss of baggage reporting at the airports, and disruption management and self-scanning of ID and passports were being introduced in phases.

The researchers were also informed that FAAN was introducing tagging, not only of baggage, but also of other movable properties for real-time resource tracking at the Lagos airport. In order to enhance passenger experience at airports, investments in smarter technologies were on the agenda in the short as well as medium term. For instance, digital touch-screen kiosks, GPS/GPRS technologies for directional support, smart cards holding complete information about the passenger, and digital shopping and courier dispatch systems are expected to be in place in the next 10 years at the Murtala Mohammed Airport. The authority was planning to experiment with biometric identification systems, automated vehicle identification, parking-lot management, integrated boarding pass generation systems and self-service baggage drop, all of which are expected to be in-place within the next 5 to 10 years.

To underpin the finding about the relatively lower level of availability of aviation-specific technologies than conventional technologies, was the information that ten 3-dimensional scanners—purchased by the federal government for use at the Lagos airport—were yet to be deployed seven months after. The respondent further informed the researchers that knowledge about the existence of these technologies was not necessarily because the technologies were available or that they were being used; rather, it was due to regular issues that have been raised in various meetings and conferences about the need to engage modern aviation information and communication technologies (Zaharia and Pietreanu 2018). Hence, although many workers knew about the technologies, chances were that many of them might not have seen some of the technologies. There was a finding of preference for manual systems by staff. For instance, the researchers were informed that the common-use terminal equipment (CUTE) solutions for check-in and baggage management were actually available at the airport. However, instead of using the CUTE system, customs and other officers at the counters in the airport preferred to use the manual methods, an approach that could permit security leakage such as the entrance of contraband goods.

Further, on the facilities not being adequately used, the key informant from the security department said that the airport operators expressed a feeling that some of the travellers might not be technically literate enough to use self-service functionalities comfortably. In the course of administration of the questionnaire, one of the passengers came to ask the desk staff of the organisation for the time of the next available flight, although the FIDS was directly facing the passenger. Therefore, there seems to exist some low level of knowledge among passengers about aviation information and communication technologies and how to use them. The respondent from the security department further

informed that the airports authority was apprehensive that the public might be generally ignorant about how to use the technologies, and that public enlightenment would be required to avoid the controversies the technologies generated in other countries such as Saudi Arabia, where attempts to use the scanners were resisted by travellers. The controversies are related to the fear by passengers over the extent of human privacy the technology reveals. For instance, there is fear that the use of x-ray scanners might be recording passengers' nudity, and that this information might be stored or used for other purposes. In another study, however, Jennifer (2007) showed that the use of screening technologies at the airports was justifiable, irrespective of passenger perception of security threats and of privacy sensitivity.

Another factor that could explain the non-deployment of the specific technologies was the issue of staff skills to use the equipment. The operations respondent informed the researchers that lack of training, lack of expertise and cost-related factors were among the explanations for the non-use of the technologies. Although there was an indication from the security informant that some staff of the agency had been trained in the United Kingdom on how to use some of the equipment, the Director General of the Nigerian Civil Aviation Authority was of the opinion that the government still needed to train officers to use the airport screening devices (Gambriel 2010). Beyond this, a more fundamental finding was that the airport authority is mainly a regulatory organisation and most of the self-use passenger technologies are deployed by the airlines themselves, and this situation contributes to the non-deployment of some of the technologies acquired by FAAN.

Respondents reported that aviation-specific technologies were difficult to use. The respondents indicated that flight information display systems existed and were being used, but the technology probably drew little or no attention from the passengers because the technology did not often display real time flight information. The technology is, however, still in use for mainly other purposes such as advertising products and services offered by the airlines, banks and the airport authority. The researchers were also informed that the information displayed by the flight information display system was originally expected to be part of the airport operations database, but at that stage this was not happening.

A majority of the respondents were forthcoming in offering suggestions on how to improve the utilisation of information and communication technology at the airport. The establishment of a training institute topped the list, followed by servicing and maintaining the information and communication technologies. The majority of the airport staff admitted that lack of training was a major problem in the use of ICT. Another challenge reported was the constant breakdown of the information systems as well as improper handling of the information system. The operations respondent revealed that some of the staff had trained themselves on how to operate some of the systems, but that they might not want to share the knowledge with others. Instability of power supply was also reported as a major challenge and this was supported by the total

blackout being witnessed at the airport periodically. The researchers were also informed that air traffic controllers worked for about 10 hours a day, contrary to the standard of a maximum of two hours per day. In the opinions of the staff of the organisation, the major benefit of these aviation information and communication technologies was that the technologies had greatly increased the service performance and the effectiveness of the industry. There was an indication that the travel market in Nigeria is growing, and that there will always be a relatively large group of first-time travellers for many years to come.

The researchers' scanning of the organisation showed that FAAN did have an Information and Communication Technology Department whose two-pronged mandate included hardware support/maintenance, installation of operating system server, network support and extension, network trouble shooting (WAN/LAN), internet services and support and operating system issues. The other was system feasibility studies, system analysis/design, programming, report writing/documentation, training of personnel, software implementation and support. An interaction with a senior staff member of the department showed that the staff's understanding of their department's mandate covered only conventional information and communication technologies. There was no integration of these complementary technologies into one single ICT management unit in order to streamline their services to the organisation. Practically, the convergence phenomenon is based on the compatibility of the computer with all other technologies, a development which demands that conventional and aviation information and communication technologies should be seen as playing the same roles. Ironically, while the conventional information and communication technologies are managed in the Information and Communication Technology Department, the aviation-specific information and communication technologies are managed as general aviation technologies. There appears to be a dissonance in information management in the organisation. For instance, the staff knew that there were special information and communication technologies that were used to manage information at the airport; some of them had also acquired the skill to use the facilities, but many of them did not know whether the facilities were available in the organisation or not.

Higher reported use of aviation information and communication technologies than conventional technologies by males might be because the departments selected for the study were dominated by activities mostly performed by men. Men perform many security and airport operation activities; most of the conventional information and communication technologies were mainly office management related. The heavier presence of men in aviation information and communication technologies use may also be underpinning gender bias in roles at FAAN, an issue that is beyond the scope of this present study. This analysis is supported by the finding that females were more users of conventional technologies than they were of aviation information and communication technologies. Generally, many of the conventional information and communication technologies, such as computers, photocopiers, and telephones, are technologies that are

known to be dominated by women, due mainly to the use of the technologies in office management.

By age group, the reported use of conventional technologies by those younger than 30 could be because this age group might already have had use skills of the technology before coming into the employment of the organisation; conventional information and communication technology use skills now being somewhat ubiquitous. Practically, it might not be expected that employees have use skills in aviation information and communication technologies before being employed by the organisation. The reversal of this finding in favour of the use of aviation information and communication technologies for those aged 31–40, supports the foregoing finding—those assigned to departments that use the facilities would have acquired the skill. The result of the difference in the use of the technologies by working experience (which favours younger workers) supports the foregoing finding; those who had been working only in the last five years probably had knowledge of the use of conventional technologies prior to their employment. This difference evens out with the increase in the number of years in the organisation, as employees acquire further training and skill in those specific technologies.

The non-significant relationship between the use and availability of aviation information and communication technologies could be interpreted to mean that the knowledge about the availability of the equipment does not translate to knowledge about their use by the respondents. The equipment could be available but the respondents would not know how to use them, a finding that supports Agbonlahor (2005). Again, this finding underpins an earlier finding about a possible gulf between the airport authority and its security and operations staff who are the actual users of these tools.

In the same way, the non-significant relationship between awareness and use shows further that awareness about the existence of the facilities might not result in knowledge about their use. The corollary would not be realistic since awareness about use is expected to either precede or accompany awareness about use. This trajectory of opinion supports the finding by Ayodele (2010) that some of the aviation information and communication technology facilities at the airport authority are not used at all. Those who know about the availability of the facilities also have knowledge about the existence of the technologies. This result is expected because the availability of technology, that one knows nothing about, might not mean so much to such a person. Also, those who know how to use the technologies appear to also know about the challenges that constrain using the technology. The contrast of the non-significant relationship between awareness and the challenges respondents reported facing, might be interpreted to imply that mere awareness about the existence of the technologies is insufficient for respondents to know the possible challenges they would encounter using the technologies—an expected result. This inference is supported by the result that follows, which shows that knowledge about the use of the technologies could expose one to the possible challenges that could be encountered in using the technologies.

Generally, the conventional aviation technologies were reportedly easy to use and were operated by staff without any assistance; however, the aviation-specific information systems were more convenient to use, although staff did not find them easy to operate. The conventional ICTs are now relatively old and the respondents would appear to have become very comfortable with their use; but it is not so with the aviation-specific technologies, which are not considered to be of advantage in comparison with old ICTs. This points to some contradictions in new technology implementations. This study confirms the universal truth that technologies that do not have the promise of advantages over previous ones, might not be embraced by people. Usually, technologies are tested before they are marketed. However, a crucial observation would be that the technologies are marketed beyond the environments where they are tested, with the implication that the skill required to use the technologies might be too high for some of the end users. The complexity of technology reduces its use by the intended audience. The reasons are not far-fetched; the cost of making mistakes could be unbearable, while fiddling with technology in the presence of customers could be very embarrassing. A common observation is that technology implementation in Nigeria follows the path that the technologies are acquired and installed before user training is contemplated. Practically, technologies should be identified and tested and then prospective users should be trained before the technologies are acquired. This way, organisations mitigate the embarrassments that arise from having technologies that are not used for the intended services, and or leaving installed equipment redundant while the users are undergoing training.

Conclusions

This study focused on information and communication technologies applications in an information intensive organisation—the aviation industry in Nigeria, examining whether these technologies are considered easy or complex to use by staff of the organisation, among others. A major challenge of the airport, therefore, is developing an integrated workforce that is aware and informed timely about new technologies and trained on how to use them. This observation calls for improved internal communication and improved team spirit among various cadres of staff of the organisation. Periodic briefing of staff about developments in the organisation, such as the purchase or plans to implement new technologies, improved staff education through newsletters, workshops and conferences should be executed. Further, the cost of acquisition of aviation information and communication technologies and the cost of training staff abroad to use the technologies can only be justified if the facilities are adequately deployed. This observation is underpinned by the rapidity of development and the high rate of obsolescence of information and communication technologies generally.

Recommendations

1) There is a need for greater information communication between the airport authority and stakeholders in order to drive efficiencies in airport operations. The airport should invest heavily in setting up a service-oriented architecture

platform for the airport operations control centres. However, a challenge FAAN must confront is how to educate the masses that use the services of the airports in the country, given the apprehension expressed by airport users about the information and communication technologies. One way of achieving an improved technical literacy among travellers would be to use mass media such as radio, newspapers and television. Newsletters could be distributed to travellers and other people who visit the airport, as well as the deployment of modern information and communication technologies such as the Internet.

2) There is a further need to coordinate the use of aviation information and communication technologies at the airport; different airlines use somewhat different technologies. The airport authority should be in charge of technologies used in airport operations. Presently, except for air traffic control systems and x-ray scanners, which are managed by the staff of FAAN, the airport authority does not handle most of the technologies which are rather manned by various other airline operators. The decentralisation of information and communication technologies has an advantageous implication for reduced overhead costs by FAAN, but it also implies that the organisation might lose total control of the extent and nature of information and communication technology deployment by the airlines, a situation that might weaken the efforts to improve safety and security. The solution still lies in adequate oversight of the activities of airlines by FAAN, and information and communication technologies still command an overarching role. Empirical studies grounded on the need for integrated ICT activities and workforce at the airport will be required to provide further understanding of how to improve ICT deployment and use at the airport.

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