

eAirlines: Strategic and tactical use of ICTs in the airline industry

Abstract

Information Communication Technologies (ICTs) have revolutionised the entire business world. 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. This paper discusses comprehensive research, including exploratory research with airline executives, using qualitative methods to examine the use of ICTs in the contemporary airline industry and to discuss recent developments in the industry. The work demonstrated that the airline industry was using the Internet to improve its distribution strategy and reduce costs; it also used intranets and internal systems to develop tactical and strategic management. In addition, extranets were being gradually used for communicating with partners and to support Business to Business (B2B) relationships. The effort demonstrated that ICTs will be critical for the strategic and operational management of airlines and will directly affect the future competitiveness of airlines.

Keywords: Airlines, tourism, transport, Information Communication Technologies, Internet, Intranet, Extranet,

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1. ICT strategic implications for business and the travel industry in particular

Information technology generates fundamental changes in the nature and application of technology in business. Information Communication Technologies (ICTs) can provide powerful strategic and tactical tools for organisations, which, if properly applied and used, could bring great advantages in promoting and strengthening their competitiveness [63,64]. The proliferation of the Internet, as a main stream communication media and as an infostructure for business transactions has generated a wide range of strategic implications for businesses in general as well as for the travel and airline industries in particular.

1.1 ICTs revolutionised business processes and practices

The recent ICT developments have enormous implications for the operation, structure. and strategy of organisations. The competitiveness of future economies will, to a great extent, depend both on the development and application of these technologies. The proliferation of the World Wide Web forced most organisations to rethink the way they do business and how they can reengineer their business processes. As businesses can interact more efficiently, competent businesses became digital and networked, facing a whole range of fresh opportunities and challenges [75,76,77]. The eCommerce revolution is evident on a global basis, although the level of success often depends on a wide range of local factors [66]. Porter [65] illustrates that ultimately technology can totally transform the way an entire business is done.

ICTs contribute towards efficiency, productivity. and competitiveness improvements of both inter-organisational and intra-organisational systems. The relationship between ICTs and competitive advantage and performance is still unclear [14,19]. Although there is an indirect and complex casual relationship between ICTs and profitability, it is difficult to be quantified and generalised. There is evidence, however, that well-managed ICTs can generate tremendous value for organisations [48]. Technology has already revolutionised a wide range of functions including business functions [73], external environment monitoring [86], communicating with partners and with consumers at large. Clear strategic goals and commitment are prerequisites for the development of an appropriate eCommerce strategy and the development of web sites and other technological solutions [46]. The emergent mobile technologies and mobile commerce are expected to change drastically a number of industries and to force organisations to reconsider their strategic management [5].

1.2 ICTs in the travel and tourism industries

The travel industry already uses a wide range of ICT systems [62,82,69,9]. The Internet in particular allows them to demonstrate their competencies widely as well as to communicate directly with their prospective customers. Increasingly, intranets are used to offer user-friendly access to employees of organisations, as well as extranets which provide authorised partners with the ability to use company data to transact online. In addition, several internal-management applications facilitate the strategic and operational management and marketing of travel organisations.

ICTs support all business functions and are critical for operating in the travel industry as a whole. Few other industries rely on so many partners to collaborate closely for delivering their products and few other value chains are as elaborate as the one for travel [8]. ICTs provide the tools to search for meaningful and profitable niche market segments, to identify value added components

for the product and to promote differentiated products through specialised media to particular market segments. Cost effectiveness and flexibility are critical assets contributed by ICTs in this process, as they assist cost reductions and maximise efficiency. The influence of ICTs on travel organisations is pervasive, as information is critical for both day-to-day operations as well as the strategic management of organisations. On the strategic level, travel organisations have to continuously assess all elements of their external environment, as well as their competition and customer needs, and consequently, adapt themselves in order to enhance their competitiveness. Using ICTs, tourism organisations can differentiate their product customising the final product and adding value according to individual requirements.

ICTs support the strategic management of travel organisations by empowering long-term decision making and by providing a platform for collaboration and transactions between partners. They also help the entire industry to operate by empowering internal processes, co-ordinating partners, as well as by interacting with prospective travellers and the general public. As a result, the recent ICT developments have revolutionised the entire system and have profound implications for both the strategic and tactical management of travel organisations. More importantly they have dramatically changed the industry structure and altered the competitiveness of all players in the marketplace [9,61].

1.3 ICTs in airlines : Research Objectives

This paper analyses the use of ICTs in airlines as part of the travel industry. It aims to explore the role of ICTs in the contemporary airline industry and to investigate the strategic and tactical tools currently utilised. It focuses on the generic strategic and operational management of airlines and identifies some of the most critical ICT issues that will affect the future competitiveness of carriers.

There are a number of different types of passenger airlines, including:

- Scheduled (often flag carriers) such as British Airways or United Airlines
- No-frills (or low cost) carriers, such as Easyjet, Ryanair and South West Airlines
- Charter airlines, such as Britannia Airways and Hapag-Lloyd Flug, carrying Tour Operator's customers to resorts [84].

This paper primarily concentrates on scheduled and no-frills airlines, as charter airlines use different distribution mechanisms to display their availability and prices. However, the distinction between these types of airlines is increasingly becoming unclear, as each type of carrier is trying to enter each other's market. However, no-frills airlines as new entrants have been much more technologically innovative, and these innovations are identified in the analysis.

2. Historical developments and the use of ICTs in the airline industry

Airlines are advanced users of ICTs and a number of airline functions rely heavily on ICTs [12,23, 36,24,11,22,78]. Distribution and collaboration with partners is perhaps one of the most critical areas of ICT contribution [70,25,39,13]. Many low-cost carriers rely exclusively on ICTs for displaying their availability and for communicating and transacting with their clientele. ICTs are equally important in operations management and contribute to the optimisation of procedures and processes [40,87,88,18] as well as for softer service elements such as in-flight entertainment and customer service [2].

Airlines have been investing heavily in ICTs since the 1950s. They have pioneered the introduction of ICTs as they realised, fairly early, the need for efficient, quick, inexpensive, and accurate handling of their inventory to communicate with travel agencies and other distributors. Carriers appreciated that reservations could no longer be on manual display boards, where passengers were listed, as they expanded their fleet and routes. Up to the 1970s, most travel agencies had to locate the best routes and fares for their customers in a manual (such as the Official Airline Guide and the World Airways Guide ABC). They then had to phone for availability, reservation and confirmation before issuing a ticket manually.

In 1962, American Airlines introduced its SABRE Computer Reservation System (CRS) as an alternative to expanding its Boeing 707 fleet by 50%, (from 8 to 12 aircrafts). The project was then described as "a technical marvel representing a programming task that surpassed the coding effort required for NASA's Project Mercury" [27]. By the mid-1970s SABRE was much more than an inventory-control system. Its technology provided the base for generating flight plans for aircraft, tracking spare parts, scheduling crews and developing a range of decision support systems for management [15, 44]. Ever since, every single airline has developed, purchased or leased a similar system in order to satisfy similar needs.

In the 1970s, the USA air transportation deregulation enabled airlines to change their routes and fares as frequently as desired. This generated an enormous growth of air traffic as well as a greater demand for information [28,83]. Hence, the demand for efficient and effective internal and external communication with all airline stakeholders stimulated the development of CRS as central planning administration and commerce platforms for airlines. CRSs allowed airlines to improve their internal organisation and also provided a powerful tool to manage their inventory. They also enabled airlines to communicate with travel agencies, consolidators and other distributors and to update routes, availability, and prices constantly. Following the deregulation, "fare wars" multiplied the fares structure and increased the computing and communication needs. Carriers used the newly emerging computer technology to manage reservations and fare data more accurately and efficiently. The sophistication of CRSs expanded in order to distribute up to date information to all potential customers world-wide and to support the operation and administration of airlines. In addition, CRSs allowed airlines to compete fiercely by constantly adapting their schedule and fares to demand. CRSs were effectively developed to marketing and distribution systems and contributed significantly to the competitiveness of vendor/host airlines [79,6].

Gradually CRSs became strategic business units (SBU) in their own right, due to their ability to generate income and boost airlines' sales at the expense of their competitors [16]. CRSs introduced three major financial benefits for vendor airlines, namely: a wide distribution network and CRS services; revenues generated from services to third parties, and incremental benefits through directional selling to the parent carrier [72,49,17, 80]. Fare wars complicated the fares structure and increased the computing and communication needs. Most major CRSs installed terminals in travel agencies to assist remote printing of travel documents such as tickets and boarding passes, itineraries

and invoices. They also improved the efficiency in arranging sales settlements between airlines and travel agencies, and empowered frequent flyer programmes. Eventually, every airline developed or purchased its own system, which was run domestically and primarily served its national market [53,81].

In the mid-1980s, airline and CRS executives realised that air transportation was a fairly small part of a much more complex travelling experience. Travel agencies were demanding access to a number of carriers from a single terminal, as well as information on value-added products at destinations. CRSs therefore were developed to much more comprehensive Global Distribution Systems (GDSs) to offer a wide range of tourism products, such as hotel and car rental reservations. Single CRS systems, such as SABRE, developed their database to include itineraries and inventory from other airlines, whilst two groups of scheduled airlines emerged in Europe to develop the Galileo and Amadeus GDSs [85,29]. GDSs still provide the backbone mechanism for communication between principals and travel agencies. They hold millions of fares in a database with up to 40 million changes entered every month. Moreover, GDSs developed their capacity to handle more than 500,000 passenger name records and nearly 2,000 messages per second [38].

Since the early 1990s, GDSs effectively became travel supermarkets, offering information and reservation capabilities for the entire range of travel products, including accommodation, car rentals, schedules for non-air transportation etc. GDSs enabled travel agencies to access all essential information on their screens and to develop comprehensive travel itineraries from the convenience of one inter-connected system. GDSs are at the heart of scheduled airline operational and strategic agendas as they control and distribute the vast majority of the airline seats. Strategic alliances, consolidations, mergers and interrelations between CRSs resulted to four major GDSs, namely SABRE, Worldspan, Amadeus, and Galileo [43]. These GDSs compete fiercely for recruiting travel agencies and for penetrating the marketplace and aim to do that by developing a number of value-added services for travel agencies and airlines [71]. Table 1 demonstrates that GDSs emerged as highly successful businesses in their own right and often were far more profitable than their airline parents themselves [32].

Table 1: GDSs Operating Statistics

Company	Period Ending	World wide locations	Segments per year (m)	Total Revenues (m)	Operating Expenses (m)	Operating Income/ Loss (m)	Operating Margin	Other Income (m)	Less Taxes (m)	Net Earnings / Loss (m)	Net Margin
Sabre	2/31/99	N/a	353	\$2,434.6	\$2,062.1	\$372.5	15.3%	\$155.4	(\$196.0)	\$331.9	13.6%
Galileo International	2/31/99	40,192	325	\$1,526.1	\$1,213.2	\$312.9	20.5%	\$361.2	(\$143.0)	\$218.2	14.3%
Amadeus	2/31/99	48,126	269	\$1,316.2	\$1,093.4	\$222.8	16.9%	\$25.2	(\$77.5)	\$170.4	12.9%

Source: [56] Global Aviation Associates, 2001

3. Airlines and the Internet revolution

The emergence of the Internet in the mid 1990s as well as the development of Intranets and Extranets forced airlines to refocus their strategy on technological innovations in order to enhance their competitiveness. Airlines identified the Internet as a major opportunity to tackle distribution costs and to reengineer the structure of the industry. In a recent interview, British Airways CEO, Rod Eddington admitted that BA spent £1.1 billion on distribution in 2001 and that was their third most significant expense after labour and fuel [56]. In the Internet era, GDSs as independent business from airlines developed their offerings to provide the backbone for the entire industry to establish the infostructure for the transactions undertaken by a number of Internet travel portals. In addition, they gradually reinvented themselves to main technology suppliers for a wide range of tourism organisations including airlines, travel agencies and Internet travel portals.

At the same time, a number of no-frills airlines emerged in both Europe and the US. These airlines concentrated on lower input cost in as many areas of their operations [4]. They also developed simple distribution strategies and took full advantage of the Internet for communicating with their clientele [55]. Internet early adopters, including both well-established and newly-founded airlines identified a clear opportunity. They invested heavily in order to develop their on-line brand name and to capture a significant market share. Pioneers included established airlines, such as American Airlines, and newcomers such as Bratthens, Ryanair and Easyjet that adopted the Internet from the early stages. Several carriers even painted their aircraft with their Internet address whilst they arranged special promotions with newspapers to drive traffic to their web sites. They provided incentives for consumers to book online and ensured that they were not distributed through the GDSs, in a way forcing their clients online [13]. EasyJet and Ryanair, for example were taking the vast majority of their bookings through the Internet by 2002 and passed on their cost savings to consumers by giving a £5 discount on a return fare. No frills airlines, empowered by the Internet and other ICT tools, made the industry reengineer itself as it introduced a number of ICT-enabled innovations including:

- Electronic/paperless tickets
- Transparent and clear pricing led by proactive and reactive yield management
- Single fare tickets with no restrictions on staying or Saturday nights rules
- Commission capping and publication of net fares
- Financial incentives for self-booking online
- Auctions and online promotions
- Powerful Customer Relationship Management Systems
- Online and context-relevant advertising

As consumers enjoyed interacting directly with airlines and benefited from lower rates, traffic for traditional scheduled airlines and flag carriers declined. They therefore had to follow the lead of no-frills carriers and to develop their online presence in order to maintain their competitiveness. In the 2001 Airlines IT Trends survey it was revealed that airlines moved fast to Internet Protocol (IP) based systems, having either to modernise legacy systems or to invest in new technological solutions. Getting closer to customer and cutting costs were the main key drivers for ICT projects and 20% of carriers have already moved to IP based systems and are enjoying the business and cost benefits. Another third is expected to join them in the next two years and over 90% of the carriers are reported to have started the migration to IP. Just 6% of tickets are currently sold online, using web based services and airlines gradually see their own web sites as the most important distribution channel. It is estimated that by 2007, online sales and e-ticketing will become the major distribution mechanisms worldwide [58].

4. Methodology

Consistent with the emerging nature of the ICTs and the constantly moving structures of the airline industry, this paper aims to answer the “how” and the “why” questions, rather than to quantify and verify particular variables. As there is insufficient literature on the topic and the use of ICTs in airlines is very dynamic, it was decided that exploratory research would better serve our purposes. The qualitative approach enables the appreciation of all aspects of the subject and to develop variables that can possibly be used later [67,21,35]. This effort therefore concentrated on the reasons why technology was deployed and how it can assist the strategic and operational management of airlines. The work was undertaken in early 2002 and allowed us to develop a holistic approach in assessing the strategic and tactical impacts of ICTs for airlines.

The work was undertaken in three stages. Firstly, secondary research was used to revise the theoretical framework and to identify previous research. As technology is moving fast here, only articles, reports, and books specialised in the ICTs in air transportation published in the last few years were used. In addition, a number of articles and books that demonstrated the historic development of ICTs in travel and air-transportation provided the strategic management framework and identified critical applications. The second stage concentrated on an analysis of the web presence for 40 major carriers, as demonstrated in Figure 1. Each web site was visited and explored. The level of eCommerce opportunities as well as the comprehensiveness and user-friendliness were examined. A number of value added services were identified and explored, whilst a list of links and partners was collected for each airline. Extensive notes were taken in order to identify the level of interactivity with consumers and other stakeholders. In addition, an analysis of ICT providers for airlines was undertaken to explore the kind and type of services offered in the marketplace. A list of the major suppliers researched is illustrated in Figure 2.

The third part included semi-structured telephone interviews with airline executives. About 20 airline Chief Information Officers or Distribution Managers were contacted and eight agreed to participate. Although the number of airlines could have been improved, it was decided that an in-depth analysis was better. The interviews aimed to explore *what* technology was used and *for what purpose*, on both strategic and tactical fronts. Interviewees were actively encouraged to speculate on the future ICT solutions as well as to predict how ICTs might influence the structure of the industry as a whole. A standardised, but open-ended, approach to questioning was used; some areas were explored in greater depth, through probing questions not originally included in the interview schedule. Interviews were tape-recorded and tapes were listened to during the analysis stage for further input. In addition, notes were kept on all questions asked. The semi-structured discussion enabled the researcher to interact with participants and to identify and clarify critical issues. Following the analysis of the unstructured interviews, a further round of qualitative work was undertaken, mainly to qualify, support, and appreciate the findings. A number of interviewees were asked to comment on some key finding and to provide their expert opinion.

Figure 1: Airlines researched on-line**AIRLINES**

1. Aer Lingus www.aerlingus.ie
2. Aeroflot www.aeroflot.org
3. Air Canada www.aircanada.ca
4. Air France www.airfrance.com
5. KLM UK www.klmuk.com
6. American Airlines www.aa.com
7. Austrian Airlines www.aua.com
8. British Airways www.british-airways.com
9. British Midland www.iflybritishmidland.com
10. Canadian Airlines www.cdnaair.ca
11. Cathay Pacific www.cathaypacific.com
12. China Airlines www.china-airlines.com
13. Continental Airlines www.continental.com
14. Delta Airlines www.delta.com
15. Easyjet www.easyjet.com
16. El Al www.elal.co.il/
17. Emirates www.ekgroup.com
18. Finnair www.finnair.fi
19. Iberia Airlines www.iberia.com
20. Icelandair www.icelandair.is
21. Japan Airlines www.jal.co.jp/e/index.html
22. KLM www.klm.nl
23. Lauda Air www.lauraair.com
24. LOT Polish Airlines www.lot.com
25. Lufthansa www.lufthansa.com
26. Malaysia Airlines www.malaysia-airlines.com
27. Mexicana www.mexicana.com
28. Northwest Airlines www.nwa.com
29. Olympic Airways www.olympic-airways.gr
30. Qantas Airways www.qantas.com.au
31. Ryanair www.ryanair.com
32. SAS www.scandinavian.net
33. Saudia Airlines www.saudiairlines.com
34. Singapore Airlines www.singaporeair.com
35. South African Airlines www.saa.co.za
36. Southwest Airlines www.iflyswa.com
37. Swissair www.swissair.com
38. Turkish Airlines www.turkishairlines.com
39. United Airlines www.united.com
40. Virgin Atlantic Airways www.fly.virgin.com

Figure 2 Airline ICT providers

<u>GDSs and IT providers</u>	
SABRE	http://www.sabre.com
WORLDSPAN	http://www.worldspan.com
AMADEUS	http://www.amadeus.com
Galileo	http://www.galileo.com
<u>Airline Systems</u>	
IBM	http://www.ibm.com/solutions/travel/
Lufthansa	http://www.lsyna.com/
LIDO	http://www.lido.net/
Open Skies Navitaire	http://www.navitaire.com/index.htm
SITA	http://www.sita.net/
NCR/Teradata	http://www.teradata.com/solutions/travel_industry.asp
ORACLE	http://www.oracle.com/industries/travel_transportation/
International Air Transportation Association (IATA)	http://www.iata.org/
Inflight Catering Association	http://www.ifcanet.com
Airport Technology	http://www.airport-technology.com/

Content analysis was employed to analyse the data and information from the three stages was incorporated in a framework that identified systems

- dealing with customers and stakeholders through Internet interfaces,
- targeting external partners through dedicated linkages and extranets, and
- addressing operational and strategic needs through internal systems and intranets.

The adopted methodology offered a depth of knowledge on the area and allowed the researcher to collect qualitative and exploratory information that supported the strategic analysis.

5 Strategic and tactical role of ICTs for airlines

The level of ICT utilisation in airlines is variable. However, all carriers depend on ICTs for their strategic and operational management and employ ICTs for a wide range of business departments. Interviewees suggested that they use software to support their business functions, including accounting, financial management, human resources, procurement etc. However, we concentrated only on airline-specific software and systems that enable the operational and strategic management of airlines. An emphasis was given on distribution and marketing, as this has emerged as one of critical aspects of airline strategy.

From a strategic point of view, airlines use technology to develop and manage their business model as well as to monitor the external environment and competition, undertake revenue analysis, forecasting, maintain historical data, predict demand, and design desirable products. ICTs are critical for monitoring and forecasting the performance of Strategic Business Units and for deciding which markets airlines should penetrate and how. Routes and crew planning, frequency of service, choice of aircraft and developing relationships with strategic partners are key functions supported by ICTs. Similarly strategic pricing and yield management are also supported by running complex algorithms to establish best performance and profitability levels.

ICTs also allow airlines to reduce their dependence on intermediaries and that has direct strategic implications for their partners and strategic alliances. Airlines executives admitted that this is more evident in no-frills carriers, which had no distribution or “technology baggage to carry forward.” They claimed that it was easier for no-frills airlines to take advantage of the Internet, as they had no established distribution network and dedicated departments to look after travel agencies. At the same time they had no legacy systems and dedicated links to GDSs and hence they were able to assess the situation more objectively. Many no-frills carriers decided that communicating directly with consumers was much more cost-effective than going through intermediaries. They also decided not to distribute their seats through GDSs. The cost of about \$4 per segment for each booking (regardless of whether that booking was honoured with a purchase), as well as the high degree of cancellations experienced, were very expensive to bear, especially for low cost seats. No-frills airlines therefore adopted the Internet as their main distribution mechanism and disintermediated the distribution channel, placing scheduled airlines at a disadvantage. For example Continental is reported to pay GDS booking fees of up to \$17 per passenger and a total distribution cost of \$1bn per year [3]. Major scheduled carriers around the globe have therefore generally introduced commission capping and have invested heavily in driving Internet traffic to their web sites for online bookings.

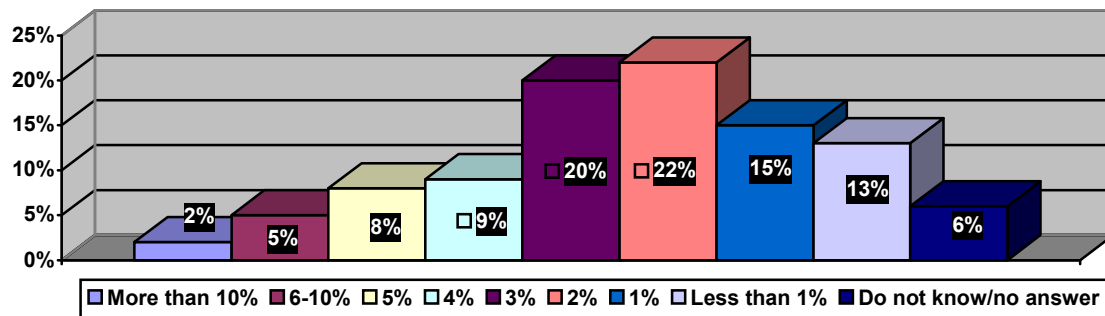
Branding and communication of principles are also critical for airlines at the strategic level. Managing communications with all stakeholders, including investors, press, employees and customers, is of paramount importance. ICTs-enabled communications assisted airlines to interact with all their stakeholders and to update them with regards to their initiatives and developments. Many carriers used their web sites as main information points following the September 11 attacks, as well as other disturbances in their services emerging from their external environment, such as wars, earthquakes, SARS etc. Gareiss demonstrated how Continental managed the September 11th crisis using cutting edge ICTs [30]. Interestingly, although the Internet provision was originally in their ICTs department, most airlines set up digital marketing and distribution departments to work together designing interfaces and devising successful strategies to attract and retain consumers. Consistency of on-line and off-line branding was one of the key issues highlighted as a factor for success. Airline executives also mentioned that ICTs become a prerequisite for developing partnerships and alliances with other airlines, as well as for monitoring competitors.

ICTs are critical for the operational management of airlines, as illustrated in Figure 3. There are several requirements including check-in, allocation of seats, generating a number of reports and orders, such as flight paths, weather forecasts, load and balance calculations, manifests for airport immigration and security authorities, in-flight catering orders and crew rotas. ICTs also assist a number of functions including inventory and reservations management as well as ticketing. Airlines have bases and distributors around the world, particularly at destinations they serve. Hence, they need efficient co-ordination and communications with stations, branches, distributors, and customers globally. Interaction with distributors, travel agencies, and other distributors can determine levels of sales whilst efficient invoicing and revenue collection is critical for both cash flow and profitability. Finally, airlines have been investing in Customer Relationship Management programmes in order to improve their direct communication and to manage their loyalty clubs. Increasingly, eTicketing instigates paperless transactions, while offering significant savings. Tactical pricing, yield management, and special offers and promotions are all facilitated by constantly assessing traffic and by taking both proactive and reactive measures to adjust demand and supply. ICTs also facilitate eProcurement and management of suppliers and partners on a regular basis. Most airlines use standardised software to undertake those functions and to generate the reports.

Figure 3: eAirlines ICT-empowered functions

Generic Airline Management • Strategic and Operational Management • Finance and accounting • Employee productivity and crew management (rota, training etc) • Relationships with partners and alliance integration • Business management and reporting • Safety and security procedures	Strategic Airline Functions • Strategic Business Unit Management • Routes Planning and market assessment • Monitoring of competitors • Strategic Pricing and yield management • Branding and communication of principles • Distribution strategy • Partnerships and alliances • Capacity and aircraft decisions
Interface with consumers, partners agencies, other distributors and ticketing • Inventory management and distribution of tickets • Customer profiling, customer service and communication with consumers • Management of inventory and bookings through GDSs and the Internet • Customer Relationships Management • Managing loyalty clubs • Reservations management, ticketing and electronic ticketing • Operational management • Tactical pricing and yield management • Promotions, special offers and targeted campaigns • eProcurement and management of suppliers and partners • Communications and transactions with stations, branches distributors and customers globally • Invoicing and revenue collection • Co-ordinating with partners and alliance members	Tactical planning and running the business • Reservations and revenue support • Check-in procedures and seats allocation • Gate management and reporting to authorities • Management of in-flight catering • Airport passenger handling • Cargo management, • Baggage handling and monitoring • Pricing, ticketing, revenue and yield management • Networking and schedule development • Scheduling, operational management and control • Crew management and control • Maintenance management and control • Procurement of materials and equipment • Coordination of stations and hubs • Weather, fuel and rota reports and manifests • Critical incidents management and corrective mechanisms

Airlines had to invest significantly in their ICT systems in the late 1990s in order to develop interfaces with consumers and the travel trade. The level of investment in ICTs illustrates their critical role. In the IT Trends Survey 2001 [59], the average planned ICT expenditure for 2001 was 2.8% of the airline revenues. Figure 4 demonstrates that 24% of the respondents had planned to spend more than 4% of their revenue on ICT investments. The importance of ICTs is also evident by the fact that 29% of the carriers surveyed have started pilot studies using wireless and mobile technologies, whilst 60% now have ICTs represented at the board level.

Figure 4: Planned ICT investment as percentage of airline's revenue in 2001

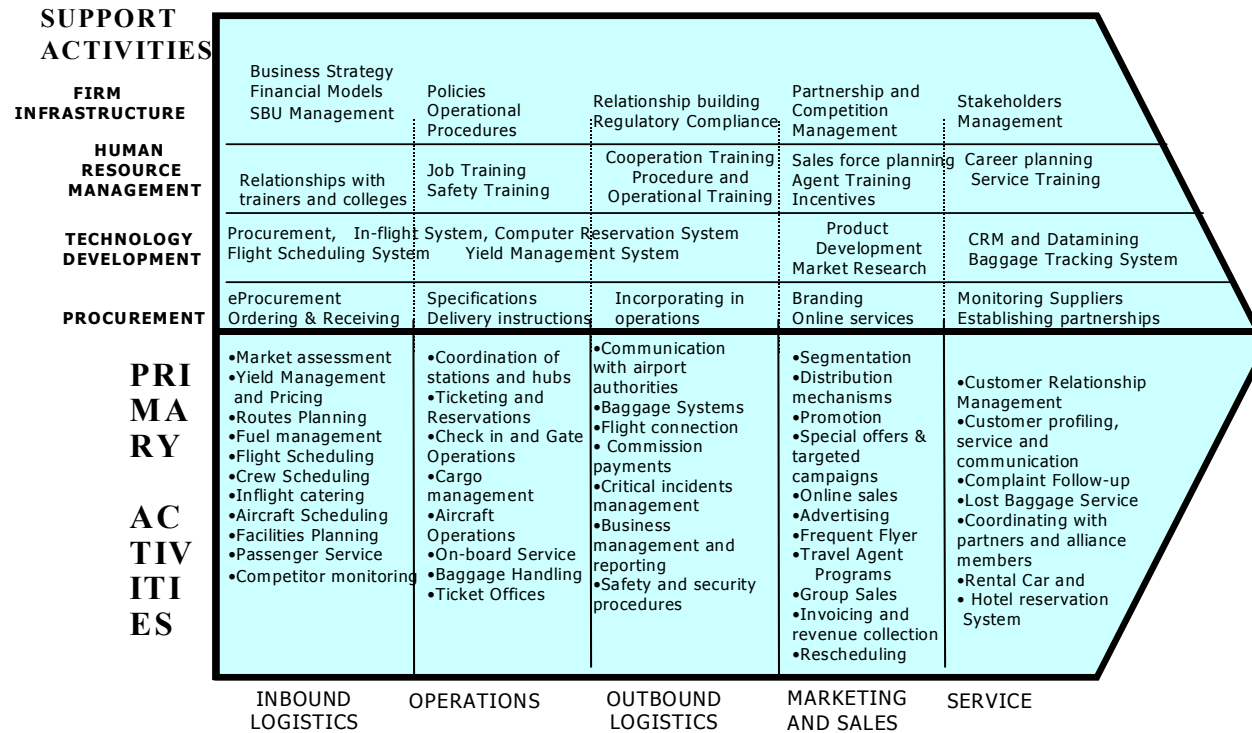
Source: O'Toole, [60]

Interviewees suggested that in the last few years, ICTs emerged from a pure infrastructure department to a critical enabler of the entire range of the airline business processes. ICTs effectively determine the competitiveness of airlines, as they are embedded in every simple element of the airline value chain, as illustrated in Figure 5.

5.1 Internal Systems and Intranets

In order to perform the tasks, airlines use a wide range of internal systems and intranets to coordinate their activities. Interviewees were requested to explain the types of systems they use and the main purpose that they fulfil. Internal airline systems were then classified into sales and marketing support systems, operational, and resource management systems. A number of information management and decision support systems underpin the airline's core business processes and operational management. Interviewees suggested that airlines aim at maximising their profitability, by optimising their total yield and by minimising costs. This process is facilitated by a number of integrated systems that operate in parallel to coordinate a number of critical airline functions, such as accounting, financial management, human resources, etc. In addition, specialised software facilitates scheduling in order to optimise crew, aircraft, and other resources and to maximise the operational efficiency whilst keeping costs under control. These systems are similar for all types of airlines and there were no major differences between scheduled, charter, and no-frills airlines. However, no-frills carriers and charter tended to schedule their flight programmes more tightly and therefore they tended to have a greater number of indicators and controls.

Figure 5 ICT enabled Airline Industry Value Chain



5.1.1 Sales and marketing support

Airlines have long used internal Computer Reservation Systems. They are often interfaced with GDSs and with the airline Internet site in order to distribute inventory globally and to ensure that it is current. These systems are used to issue electronic tickets and to exchange e-tickets with multiple carriers worldwide. Interviewees suggested that they desperately need to promote their web site as their primary reservation path and as an alternative to the GDS/travel agency route. Such systems link all partners in the handling process, automate procedures, and support smooth communication flow. Airlines endeavour to use technology to enhance their efficiency and therefore they attempt to integrate new technologies such as electronic scales, stacker systems, handheld terminals, and bar coding to increase their handling efficiency and to reduce operational costs. Therefore, these systems support the administration, accounting, and passenger or cargo handling processes by coordinating inventory management, sales and marketing, yield and revenue management, ticketing, and departure control systems.

Airlines use decision support systems to monitor traffic and bookings on computer reservation systems in order to identify customer behaviour, traffic flows or trends, as well as the performance of partners and sales agencies. They also follow the pricing of their competitors for numerous city pairs. These systems also enable airlines to assess their situation against the performance of their competitors and to adopt proactive and reactive measures. A broad information base leads to more suitable decisions for core airline strategy and operational activities, such as marketing and sales, schedule planning, yield management, or pricing.

5.1.2 Operational Systems

Airlines need to use effective planning processes to optimise the performance of their network. This involves maximisation of the equipment and human resources utilisation against demand pressures, government regulations, and operational constraints, such as air traffic control rules. Interviewees suggested that planning decisions range from long-term strategic issues, such as routes selection and competition monitoring, to operational considerations, such as schedules for equipment and staff rotas. Scheduling implies deciding the number of connections between airports as well as timing and choice of aircraft equipment. Planning and operations departments use Integrated Flight Schedule Management Systems to support airlines in planning their schedules. Such systems need to provide seamless integration with other systems, including Operations Control, Reservations and Revenue Management, Maintenance Control, and Crew Management. They examine historic traffic data and previous load factors as well as forecast demand figures. The proliferation of hub and spoke systems has forced planning departments to manage their network as a whole by scheduling departure waves and coordinating flights. Aiming to maximise load factors and yield management for the entire network, airlines use Flight Schedule Management Systems to predict traffic and to simulate operational discrepancies caused by delays, weather conditions, and other unpredictable circumstances that disrupt schedules.

Complementary to Schedule management systems are Operations Control systems that support the automatic calculation and distribution of flight plans, as well as other features, such as automatic consideration of all valid aeronautical restrictions in the process of the flight plan calculation. Flight Watch in particular collects and displays vital information, such as booking figures, passenger transfer information, critical weather conditions, crew rotations, airport limitations, etc. Possible problems and critical situations can be identified whilst early alert messages and updates are generated for all other operational systems, such as flight scheduling, reservation, maintenance, and crew control systems.

In addition, as airlines usually have a wide network of hubs to support, Station Control Systems monitor all kinds of connections on a hub and report on operational details, such as aircraft turns, crew connections, passenger, baggage, and cargo connections. Airports and airlines need to work together to reduce aircraft turn-around times and to shorten passenger connection times. These systems also help station managers plan their operations and ensure that all resources are in place to service each flight. Baggage handling and monitoring systems allow airlines to increase their efficiency and to track every bag as it moves through the system. This also ensures that no baggage is transported without its owner, as per International Civil Aviation Organisation regulations. The systems support reconciliation procedures of checked passenger baggage enable airlines to ensure security, reduce operating costs, and improve passenger satisfaction without compromising punctuality [20].

5.1.3 Resource Management Systems

Airlines need to maximise the utilisation of their most expensive resources: human resources and fleet. Therefore, they need to ensure that their equipment and aircraft is functional and its capacity fully used. Maintenance Control systems co-ordinate aircraft maintenance, commercial, and operational requirements. They ensure that aircraft and other equipment is regularly maintained and also that technical problems and unscheduled services are dealt with as efficiently as possible to minimise out-of-service periods whilst minimising service disruptions. Often these systems are integrated with eProcurement systems for allowing airlines to order parts and other consumables online, whilst engineering systems may be integrated for providing online manuals and technical support. Technical documentation management systems often create, distribute, and manage complex technical data and documents. Hence, airlines aim to maximise fleet utilisation by improving maintenance, repair and overhaul performance. This is achieved by optimising the supply chain network, aircraft downtime, and materials management.

Airlines also control their crew rotas through crew management systems. Planning duty rosters is a complex process as there are numerous key constraints, including skills and the ability to operate equipment, rank, immigration issues, rest periods, and cost of rest periods. Crew management systems use comprehensive crew databases to undertake pairing construction, roster generation, and crew control in order to optimise the human resources performance. They need to be co-ordinated with all associated activities, such as flight scheduling, operations control, crew contact, flight briefing, etc. These systems can also undertake a number of routine tasks, such as checking legalities, publishing rosters and notifications, and administrating hotel accommodation, dead-heads and pick-up services. Communicating scheduling information with crews (notifications) and next duty period (briefings) as well as information regarding flight load, crew composition, aircraft and airport details is also critical. A number of intranet solutions facilitate this process [45]. It is the coordination of all these systems that ensures that airlines enjoy operational efficiency and are empowered to achieve their long-term strategy.

5.2 Interconnecting partner systems and Extranets

Interviewees also explained that airlines rely heavily on external partners for their operations. Therefore it is critical to develop efficient systems for working together with them. For example, all airlines need airport infrastructure as well as a variety of partners to support their operations.

5.2.1 eProcurement: transactions and information flows with suppliers

Suitable extranets and inter-organisational systems are required to facilitate airline interaction with their regular suppliers. Airlines are customers of airports, air control systems, and other authorities such as immigration and customs. Airlines, therefore, regularly exchange information with airport authorities and air traffic control systems. These flows include requests for landing slots and docking gates, informing about arrivals and departures, altering slots, declaring flight paths, and coordinating operations. Although many airlines and airports still rely on printed forms and telephone communications, a good percentage of the interviewees suggested that ICT-enabled systems are currently constructed to support these processes. A number of airlines gradually developed or adopted electronic environments for data exchange with the Customs and Airport Authorities in their main stations. Extranets assisted them to develop reliable and direct connections and enhance their efficiency. Interviewees expected that the global security concerns will generate further regulation that will make interactive extranets a prerequisite for flying to several technologically advanced destinations, particularly the USA.

Airlines also interact with a number of organisations that provide handling services at airports, including maintenance, refuelling, security, baggage handling, load and dispatch, lounge provision, catering, and cleaner services. In most cases, these services are provided by a number of companies. The range of products and services purchased varies. One of the interviewees demonstrated the level of information required to fulfil the value chain by quoting that Air India is serving 24 different meals on board. Customer orders need to be communicated to caterers well in advance and need to be prepared, stored, and served in a particular way. In addition, handling a large amount of baggage on a daily basis between a number of airlines and airports is very complex and is facilitated by Extranets.

eProcurement is also a major force for Extranets. As airlines regularly purchase products and services, such as fuel, aircraft parts, and catering, B2B applications allow them to benefit from cost savings and efficiency. Several major airlines with large networks emerge as suppliers for other carriers as well. Lufthansa, for example, has three types of procurement tools in operation or in planning. The AirPlus "ProNet" product, offers an online catalogue system for ordering general supplies like computer hardware, forms, and office furniture. The Fair Partners web site puts all types of orders out to tender. Finally the "AeroXchange" marketplace is being set up by Lufthansa, in cooperation with most of the Star Alliance partners, as an airline industry online trading exchange that offers industry-specific goods and services ranging from special screws to aero-engines. Procurement marketplaces have become highly economical for airlines by making markets more transparent and by allowing companies to bundle their procurement volumes.

Developing B2B applications and interconnecting Extranet systems will support both airlines and their partners to streamline them and reduce their turn-around time at the airport. Clarity of communication and efficiency chain is critical for both controlling costs and delivering service.

5.2.2 Distribution, marketing and sales support with partners

The vast majority of airlines rely heavily on travel agencies for distributing their products. Interviewees suggested that the link with travel agencies is normally facilitated by Global Distribution Systems that provide the infostructure for itinerary building and facilitate the entire transaction. However, airline executives explained that they would like to transact with travel agencies on an Extranet, over the Internet, in order to avoid that GDS's booking fees for lower fares. For example, British Airways has developed a dedicated web site for the travel trade (<http://www.batraveltrade.com/>) that can be developed to an extranet in order to facilitate this process. However, travel agencies may gradually find some useful financial features. For example they will be able to process credit card payments in a way that charges the airline the cost of the

credit card fee (currently about 2%). Similarly KLM provides its web fares only on its extranet, whilst GDS fares are more expensive to cover the extra costs. Although connecting is technically possible, interviewees suggested that travel agencies are reluctant to follow this route, partly because they prefer comparing all schedules and prices on a GDS and partly because GDSs provide incentives and they have long term contractual agreements with them. Interviewees suggested that there is a great potential in these types of extranets and that the business logic will be driving technological deployment.

Airlines also appoint General Sales Agencies in all regions that do not operate their own offices. They are appointed by international airlines to secure business from IATA and non-IATA agents in markets where agency networks are yet to be fully automated and where airlines need financial security to cover business risks. They handle their reservations and distribution locally and are in close link with the Station manager to co-ordinate the activity in their particular market. In addition, consolidators pre-purchase seats in bulk and then distribute them to their local markets at discounted rates. Developing Extranets for these players and ensuring that they support their onward distribution chain, providing adequate tools to interact with all departments of the airline and managing their revenue collection on time are also critical for airline profitability.

5.2.3 Horizontal collaboration with other airlines

The vast majority of airline investment is concentrated on distribution, as it is becoming one of the most important elements of airline marketing strategy and competitiveness. Distribution strategies determine all other elements of the marketing mix. Air fares are modified by commission costs and reservation fees. The product itself is determined, since CRSs facilitate the development of hub and spoke systems as well as code-share agreements. Promotion is also influenced, as online and off-line promotional campaigns primarily aim to increase traffic to airline web sites.

ICTs will not only formulate all elements of the marketing mix of airlines in the future, but they will also determine their strategic directions, partnerships, and ownership. The global alliances, such as the "Star Alliances", are only possible because of the co-ordination that can be achieved through harmonised ICT systems or through effective interfaces. In effect consumers receive a seamless service, collect frequent flyer miles and enjoy privileges from different carriers in all continents simply because ICTs provide the "info-structure" for close collaboration. Hence, the ICTs are also instrumental for the globalisation of the airline industry.

Cooperation between two or more airlines may include code-sharing agreements, alliances, and other business arrangements [34,26,74]. Alliances can propel a number of benefits for both airlines and passengers. Naturally the level of their success depends on each individual alliance and also on the ability of the carriers to collaborate with partners in order to maximise benefits. Some of the most critical benefits are illustrated in Table 2.

Table 2 Benefits of Airline alliances

CONSUMER BENEFITS	AIRLINE BENEFITS
Fairly consistent service across several airlines and regions	Virtual expansion of network
Access to airport lounges	Access to new markets by tapping into partner's under-utilised route rights or slots
Frequent flyers miles on member airlines	Code Sharing and GDS ranking
World-wide recognition of status and loyalty club benefits	Traffic volumes and ability to feed long haul flights

• Priority reservation, standby and boarding	• Protect home markets and building presence in distance markets
• Priority baggage handling	• Common marketing and branding
• Technological solutions for travellers	• Economies of Scale through resource pooling across operational areas
• Flexible round the world fares	• Increased load factor and yield

Sources: Based on [33,1,57,7].

Interviewees suggested that if alliances are to exploit their full benefits a certain degree of systems and software interoperability should be established. Being able to communicate records electronically between different airlines is key for them to collaborate efficiently. Extranets can allow the on-line exchange of schedule information, reservations, information on frequent flyers, and market trends. They can also help to settle accounts electronically. In addition, they can credit each other's loyalty schemes and allow passengers to change their seating or meal requirements online. There are currently few alliances and airlines that use Extranets to co-ordinate their collaboration with other partners though. Interviewees suggested that the low deployment of extranets may explain the low level of integration between carriers and the limited success of alliances.

5.3 Connecting with consumers and all stakeholders through the Internet

The proliferation of the World Wide Web in the mid 1990s changed the airline business dramatically and enabled new business models to emerge. By 1998, most airlines already hosted Web sites to inform consumers and to support itinerary building, fare construction, and reservations. They enhanced their interactivity with consumers and built relationship-marketing strategies as well as frequent flyer systems [47,54,31,42,70]. Web sites also assisted airlines to launch another communication and purchasing channel in order to reduce the power and costs of conventional intermediaries such as travel agencies and GDSs.

Air transportation accounts for approximately 65% of all travel eCommerce. It is estimated that Internet bookings contribute about 5% of the total airline sales globally [50]. However there are great variations between regions and carriers. The figures quoted for American carriers are significantly greater, as a result of a greater penetration of the Internet. In the USA 11% of the airlines seats are booked online on carriers' web sites. No-frills carriers in the USA are clear front runners, with 41% of their seats booked online [51].

No-frills airlines are using their web sites to attract and communicate directly with consumers [41]. This enables them to bypass travel agencies and their commissions. In 2003, both Easyjet and Ryanair achieved more than 92% of their bookings through their web sites, whilst Southwest sold 50% of its tickets on its web site. Interviewees suggested that there are a number of reasons, as demonstrated in Table 3.

Table 3 Reasons for no-frills airlines' success in Internet bookings

Simpler Product	• Often A-B-A itineraries and tickets • One class of service • Each segment priced individually • No catering on board • No pre-allocation of seats
Simple Distribution Channel	• Single distribution channel through own calling centres and internet • Financial incentives to book online and disincentives for phone bookings • Net rates across all channels • No commitment to existing distribution channel members • Partnership with popular off-line media, such as newspapers
Advanced CRM and aggressive direct marketing	• Email and SMS driven Customer Relationship Management • Aggressive banner advertising policies • Context-based advertising • Data and email acquisition through online and off-line campaigns
Aggressive pricing and yield management	• Individual priced seats • Minimal fare restrictions • Proactive and reactive pricing • Provocative pricing starting from offering free flights
Advanced Information Technologies	• No legacy systems • No commitment to Global Distribution Systems • Paperless office and efficient procedures • Interconnectivity with technologically advanced partners
Dynamic packaging and value added services	• Proactive approach in selling complementary services, such as hotels and car rentals through white labelling • Additional value added services such as flight watch, destination guides etc

Most interviewees admitted that no-frills carriers have pioneered Internet provision. However, a number of innovative scheduled airlines have realised that the Internet should be their main distribution channel and are fighting back. Not only have they adjusted their prices and their pricing policies but they also use the Internet to demonstrate the extra value they offer for comparable prices. At the end of 2002 a number of innovative scheduled carriers achieved more than 30% of the bookings on their web site and aimed to achieve 50-70% by 2005 -- primarily achieved by offering their best fares only on their web sites. For example, British Airways' Internet site currently achieves 1.5m visits per month, whilst the average growth of on-line bookings has been 11% per month. BA aims to achieve 80% of customer trip transactions as well as 100% of the executive club transactions on their Internet site by 2004. They hope that 100% of their tickets will be electronic and that 50% of their passengers will be self-checking in. These initiatives are expected to save £100 million British pounds. By providing a colour-coded pricing interface, British Airways allows passengers to choose from a wide range of prices, determined by demand levels. The airline has also integrated its provision with its frequent flyer club as well as with its check-in facilities, allowing a seamless process. Several interviewees explained that gradually scheduled airlines will fight back and will increase their Internet bookings in the very near future.

Several structural changes in the industry have emerged as a result of the ability of airlines to communicate directly with consumers. The most useful feature is the ability to promote distressed capacity at discounted rates at the last minute. Following the September 11th events and also the consequent global unrest most airlines were able to promote heavily discounted fares via

electronic mail and auctions. As a result, they managed to sell a significant proportion of their perishable seats, contributing directly to the bottom line. Industry experts explained that this should be regarded as direct profit, as airlines would have otherwise lost this revenue.

The ability to disintermediate travel agencies has also enabled airlines to cut down commission rates. Airlines initially in the USA, and increasingly globally, reduced their commission rates (from 10-12% to 7%-0%), whilst they also introduced "commission capping" (e.g. \$50 per ticket). Major airlines quote savings of several million dollars. In addition, electronic ticketing and ticketless travel have gradually reduced distribution, fulfilment, and labour costs whilst increasing efficiency. Continental Airlines is often quoted as an example of an airline which decreased its cost by 20 million dollars simply by reducing commissions to travel agencies and by introducing electronic ticketing.

Finally interviewees explained that most airlines use their web or other specific sites to manage their relationships with a wide range of stakeholders. Shareholders and investors are informed online about the share value and other operational statistics. Environmental groups and local planners are provided with information on policies and initiatives. Airlines often provide kids activities and games to encourage younger passengers to engage with the airline, whilst a number of value added services, such as screen savers, are often available on line. Journalists are provided with newsletters and photographs whilst plane spotters and aviation enthusiasts are also catered for by a number of carriers. Interviewees suggested that developing and maintaining high visitation to their web sites is part of their strategic objectives.

6. ICT-empowered Strategic alliances

Interviewees suggested that ICTs and the Internet have gradually enabled new types of strategic alliances and have forced airlines to collaborate and compete (*coopete*) simultaneously. Alliances support the integration of their frequent flyer programs and benefits. They also provide access to business lounges and allow endorsement waivers to enable passengers to switch between airlines. Alliances support code sharing, optimisation of capacity and yield, as well as a certain level of collaboration. Co-opetition is also extended to sharing systems and ICT expertise. Almost half of the airlines within alliances are already sharing systems with their partners and another 20% plan to do so to help offering customer seamless services. Outsourcing has increased across all airlines and 85% of carriers have already outsourced all or part of their ICT functions.

Coopetition was the main driver of the development of Orbitz and Opodo as independent Internet travel agencies by airlines on both sides of the Atlantic in order to reduce the power of electronic travel agencies, such as Expedia and Travelocity, and to develop alternative distribution channels. Table 4 demonstrates the ownership of the two systems. Orbitz was designed to give access to travellers to reservations across several airlines as well as to car rental, hotels, vacation packages, and other travel products. Similarly, in Europe, nine airlines launched Opodo in Germany, the UK, and France in 2002. Further expansion into other European countries is planned for 2004 and beyond. These systems offer unbiased and competitively priced online travel service for world travel, with access to flights from over 400 airlines, 30,000 hotel properties, and over 11,000 car hire locations worldwide, as well as travel insurance.

Table4 Opodo and Orbitz ownership

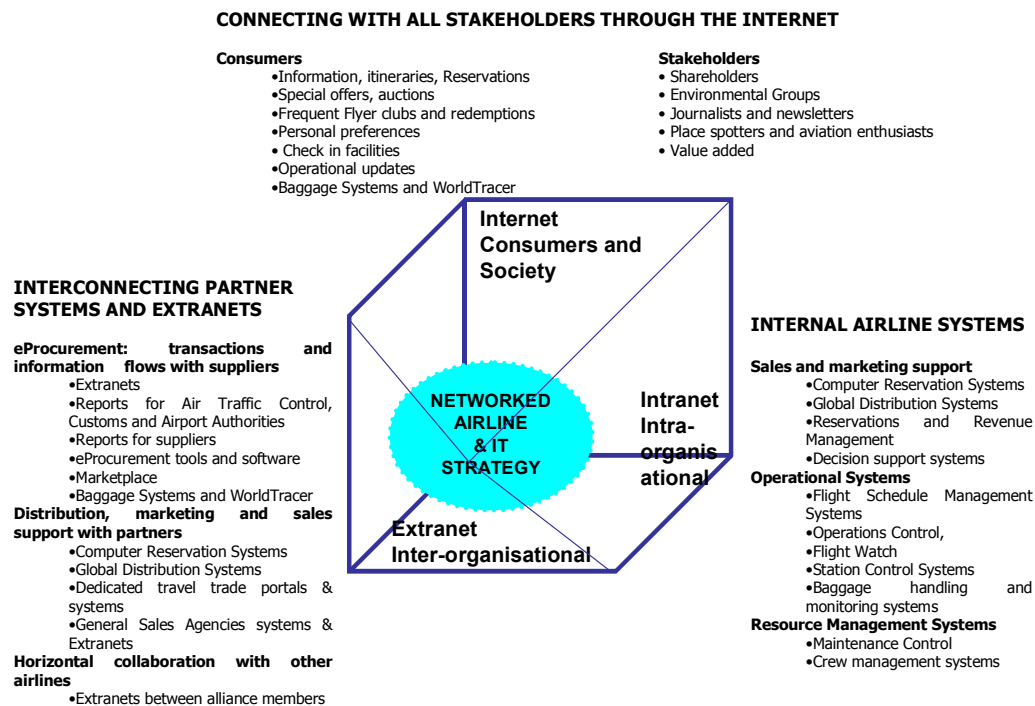
Company	Owners
Opodo	Aer Lingus, Air France, Alitalia, Austrian Airlines, British Airways, Finnair, Iberia, KLM, Lufthansa, and Amadeus (GDS)
Orbitz	American, Continental, Delta, Northwest, and United

Airlines increasingly develop links through alliances, industry bodies such as IATA and SITA, and common ventures to develop common platforms for eCommerce, eProcurement, and for facilitating their business and operational functions. These are faced with both technological and business challenges. As with many other organisations, most airlines are used to competing. Gradually they learn how to compete and collaborate with other carriers. In reality, the existing strategic alliances, such as OneWorld and the Star Alliance, have failed to develop services and collaboration beyond code-sharing and loyalty club collaboration.

Airlines need to develop stronger alliances and meaningful networks of wealth creation if they are to survive global competition in future. Business strategies and alliances management will therefore need to refocus and include ICT solutions as part of their core competence, their collaboration infostructure, and brand drivers. Only then will alliances be able to maximise their contribution and their impact in the marketplace. Business interconnectivity requires technical interoperability and airlines need to agree on technological standards and common approaches. So far, airlines are giving a confusing message. Carriers that have originally supported either Galileo or Amadeus now support Opodo whilst some from the Star Alliance and some, from OneWorld, support this venture. Unless airlines coordinate their infostructure and develop competitive online systems they will be unable to capitalise on the increasing potential of ICTs. Hitherto, they have been prevented from doing so by the dominance of legacy systems that operate on proprietary protocols and platforms. This prevents airlines from communicating and also makes it difficult to develop Extranet applications and protocols for electronic exchanges with trusted partners, such as airports, distributors, and catering and handling companies. Interviewees suggested that a certain degree of technological standardisation will therefore be required in order to support airlines in expanding their electronic exchanges and to maximise the operational efficiency of the entire system across all members of the alliance.

7 ICT-enabled airlines of the future

Airlines are one of the most interdependent organisations in the travel industry. Therefore they need to use technology strategically to integrate their operations and control and co-ordinate all their business and management functions. Figure 6 demonstrates that networked airlines of the future will take advantage of the Internet as well as Intranets and Extranets to communicate with all their stakeholders, to improve their internal efficiency and effectiveness and interact with all their stakeholders productively. Implementing enterprise resource planning can help airlines integrate all facets of their business and maximise their performance. Developing successful Extranets will also allow airlines to develop effective collaboration channels with all their partners.

Figure 6: The networked airline of the future

Managing the entire supply chain electronically can allow all partners to benefit by reducing costs, increasing their transaction accuracy, and optimising their efficiency. There is evidence that eProcurement is developing rapidly and it seems that other Extranet applications will be emerging soon to facilitate communications and interaction with Customs, Immigration, Airport, Air Traffic Control, and Civil Aviation Authorities. An integration between wireless LAN solutions will allow connections with wired LANs and will support a wide range of airline, airport, and consumer applications [68]. Outsourcing will also be a trend. Several components of airline operational systems are already operated by trusted partners and a number of specialised Application Service Providers (ASPs). Outsourcing will allow carriers to concentrate on running their business successfully and leave technology to specialised experts.

O'Toole identifies a number of challenges that are critical for airlines to maximise their ICT potential and achieve strategic and operational management objectives. These include: lack of skilled ICT personnel; lack of investment; lack of ICT personnel with airline experience; resources concentrated on legacy systems; lack of board level supervision; poor outsourcing experiences; and technology not ready yet to support the range of airline requirements. A number of business critical issues: security, customer relationship management, lack of industry standards, revenue management and protection of the brand integrity, dynamic packaging, and itinerary changes and cancellations. In addition, airlines face additional challenges following the 11th September events [37]. Safety and security have emerged as the single most critical challenge and emerging legislation will force airlines to provide better access to information for Immigration and Custom authorities. Detection security systems are expected to help airlines prevent hazardous material being taken on board and to identify defects at an early stage. In addition, tracing material, luggage, and passengers through ICT will increase efficiency and reduce theft and accidents. However, all these systems will require further investment.

Technologies can improve the entire customer travelling experience. Frequent travellers demand speedier check-in processes and a higher degree of flexibility and control over their own travel arrangements. eTicketing and paperless communications are expected to improve customer service by reducing the level of bureaucracy, by increasing flexibility, and by speeding up all processes. Self-service kiosk applications will increasingly support travellers make travel reservations, check-in, receive boarding passes, select seats, check frequent flier miles, request upgrades, purchase a ticket, print e-ticket receipts, or check bags - all without waiting in-line for an agent. Providing self-services through kiosks and wireless technologies can provide benefits including: operational and productivity gains; reduction of check-in times; support of flights to depart and arrive on-time; minimisation of check-in unit costs; improved customer satisfaction; and reduced costs. In-flight entertainment, communications and constant interaction will also be critical in future. ICTs will therefore be used dynamically before, during and after the travel experience to serve passengers and to reinforce the airline brand.

The ability of travellers to connect from virtually anywhere with their wireless devices and adapt their itinerary is expected to be one of the most widely used services [10]. Wireless solutions will empower airlines to communicate with their passengers virtually anywhere, anytime. Wireless and mobile devices, such as Mobile phones, Personal Digital Assistant (PDA), and laptops, are already used for searching and booking flights, altering flight arrangements, retrieving updated arrival and departure information, checking-in, and selecting seats. The Star Alliance allows members to download timetables and booking agents to their PDAs. Gradually, airlines will have to integrate their Internet presence with mobile portals whilst they will communicate flight alerts through a short message service or mobile email. Wireless networks are currently being implemented in several airports and airlines will need to work with ground operators to integrate their service.

8 Conclusions

ICTs play a critical role in the strategic and operational management of airlines. They not only contribute to the formulation of all elements of the marketing mix, but they will also determine the strategic directions, partnerships, and ownership of airlines. It can therefore be predicted that technology will facilitate and support the successful airlines of the future. As ICTs are instrumental in re-arranging airline alliances and concentration, it is also likely that technology may provide a major motivation for merger and collaborations.

ICTs are already instrumental for the globalisation and concentration of the airline industry. Further integration and consolidation seems inevitable. ICTs will enable airlines to establish global networks, to serve their customers better and to communicate with their partners more efficiently on a global basis. They will need to provide the "info-structure" for closer collaboration with all stakeholders available. Hence, the networked airline of the future will take advantage of the Internet, Intranets, and Extranets to strengthen its position, reinforce its brand and contribute to its profitability.

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