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A REVIEW OF ANCILLARY SERVICES IMPLEMENTATION IN THE REVENUE MANAGEMENT SYSTEMS

ABSTRACT

Ancillary services in air transport represent a set of services provided to passengers to choose from, enabling them to enhance their travel experience while accumulating additional airline revenue. Low-cost airlines pioneered the practice, but the separation of ancillary services from the basic service has become an intensely growing trend in the air transport industry over the last decade. This practice has enabled low-cost airlines to significantly reduce the price of the basic service. To remain competitive in an era of transparency provided by search engines, traditional airlines offer ancillary services in addition to the basic service. To meet the passenger's needs, a whole range of ancillary services has been created. However, existing revenue management systems do not take this ancillary revenue into account when calculating reservation limits. If the airline knew that an individual passenger is willing to pay more for ancillary services, the system would be able to adjust the availability of the service for that passenger during the booking process. A review of research on passengers' willingness to pay for ancillary services is presented in the paper, as well as a review on research on the personalisation of ancillary services and challenges of integrating personalised pricing into existing revenue management systems.

KEYWORDS

ancillary services; willingness to pay; personalised pricing; revenue management; airline; low-cost airline.

1. INTRODUCTION

The air transport industry is characterised by low profitability rates. It operates in an intensely competitive environment. The United States Airline Deregulation Act of 1978, whose main objectives were competition, liberalisation of air corridors, elimination of federal control on fares and improvement of service levels, started a process that radically changed the air transport market [1]. The process of deregulation of air transport in the United States and gradual changes in a similar process known as air transport liberalisation in Europe (that started in 1983), has led to a series of innovations in the air transport industry. Airlines were able to change prices, itineraries and service levels, independently without the approval of the government. Larger airlines, such as majors (US airlines with over one billion US dollars in revenue during a fiscal year), accelerated the development of Computerised Reservation Systems (CRS) and Global Distribution Systems (GDS) and hub-and-spoke networks, which allowed them to offer the service in more markets than it was possible with the previously established classic point-to-point service.

Traditional airlines, faced with the problem of reduced profitability due to cyclical economic trends, economic crises, high fixed costs, declining basic service revenues and fuel price volatility, have discovered tactics to increase total in-flight revenue that included better market understanding, demand forecasting on micro levels and immediate response to challenges. It led to the development of a new business discipline in the 1980s – revenue management. The main task of the revenue management system is to allocate seats in different booking classes to maximise total revenue on the flight or calculate the number of seats that should be saved

for high-paying passengers whose booking requests come at the end of the booking process. The constant advancement of information technology has brought the development of computer programs that enable real time decision whether to accept or reject a seat request.

The stages of evolution of revenue management systems mainly differ according to the level of complexity and sophistication. The first systems were designed to simulate demand and monitor the reservation process based on the data collected. The current generations of revenue management systems are based on the assessment of the passengers' willingness to pay (WTP) of the basic service and the likelihood that the passenger will spend more, i.e. upselling [2].

By drastically reducing the cost of the basic service, low-cost airlines have gained a competitive advantage over traditional airlines because, in an era of transparency provided by Internet search engines, passengers could easily compare fares. A new rule was established; the price offered by traditional airlines was considerably higher than the one offered by low-cost airlines. The fierce competition that followed in the air transport market also encouraged traditional airlines to implement similar practices offering a lower price of the basic service with the separation of all other amenities being charged separately to remain competitive when compared to the low-cost airlines [3].

Throughout history, traditional airlines have combined all the extras with the basic product – transportation, within the ticket fare, thus potentially mismanaging the expectations of passengers [4]. With the occurrence of low-cost airlines, services previously integrated into the fare became an ancillary product or service on the flight, and many traditional airlines followed the suit when they recognised significant potential for increasing profitability. They intensively launched ancillary programs and created a range of separate offers and ancillary products to meet the needs of different market segments while increasing competitiveness and maintaining market share in the air transport market [3].

The objective of the paper is to review the literature on airline ancillary service implementation in the revenue management systems, specifically focusing on publications regarding willingness to pay for ancillary services and implementation of ancillary services pricing personalisation. For this purpose, an extensive bibliographic analysis was conducted to identify, organise, single out, review and systematically present scientific papers from significant publications using keywords that are relevant to the problem being addressed in the paper. For example, when searching through Web of Science and Scopus, we selected relevant subject areas: airline, airline business, transport, transportation, engineering, management, etc. The chosen time range was the last decade, mainly due to the fact that the airlines did not offer various ancillary services prior to that period. Largest number of papers reviewed was published in the Journal of Revenue and Pricing Management – a journal covering wide range of practical, theoretical and applied research in the fields of revenue management (RM) and pricing with the quartile Q2 in year 2019 and Q3 in 2020. Journal of Air Transport Management is another journal with a substantial number of publications regarding ancillary services. Its focus is economic, management and policy issues related to the air transport industry, with quartile Q1 for the years 2019 and 2020. Other journals considered for the review belong to the first or second quartile and are focused on transportation and air transport industry, such as Transportation Research (Part A and Part E), Transport Policy and European Journal of Operational Research. Most of the authors of the reviewed papers are from USA, UK and European Union member states, with only one paper from China, and one paper written in collaboration of US authors and authors from India.

Studies reviewed are categorised into two groups regarding the focus of their research: willingness to pay for ancillaries vs. personalisation of ancillaries. *Table 1* provides a summary of studies on willingness to pay for ancillary services; year and journal (or proceeding) of publication, country of first authors affiliation, Web of Science quartile for the journal (if existing) and a methodology used in a paper.

Table 2 provides same information as *Table 1*, but for papers regarding personalisation of ancillary services.

The paper is structured as follows: in Section 2, a framework and categorisation of ancillary services is presented, along with the trends and justification for the implementation of those services in the revenue management systems. Section 3 builds upon problem description – decades long tradition of precisely determining the price of the basic service through revenue management systems compared to

Table 1 – Summary of studies of willingness to pay for ancillary serivces

First author	Publication	Country of the first authors affiliation	WoS quartile	Methodology
Tuzovic S (2011)	Proceedings of QUIS 12, Ithaca, NY	USA		Survey
Garrow L (2012)	Transportation Research Part A	USA	Q1	Data analysis, airline management interviews
O'Connell JF (2013)	Journal of Air Transport Management	UK	Q2	Online survey
Wittmer A (2014)	Journal of Air Transport Management	Switzerland	Q2	Survey
Scotti D (2015)	Transport Policy	Italy	Q1	Data analysis
Warnock-Smith D (2017)	Journal of Air Transport Management	UK	Q2	Online survey
Bockelie A (2017)	Journal of Revenue and Pricing Management	USA	Q2	Integrated passenger choice model development
Reales CN (2017)	Journal of Air Transport Management	UK	Q2	Survey
Rouncivel A (2018)	Journal of Air Transport Management	UK	Q2	Survey
Chen M (2019)	Transportation Research Part E	USA	Q1	Dynamic pricing model development and simulation
Shaw M (2021)	Journal of Air Transport Management	Ireland		Survey

Table 2 – Summary of ancillary services personalization studies

First author	Journal	Country of the first authors affiliation	WoS quartile	Methodology
Westermann D (2013)	Journal of Revenue and Pricing Management	Qatar	Q2	Discussion
Wittman MD (2016)	Journal of Revenue and Pricing Management	USA	Q2	Simulation
Wittman MD (2016)	Journal of Revenue and Pricing Management	USA	Q2	New heuristics development and simulation
Madireddy M (2017)	Journal of Revenue and Pricing Management	USA	Q2	Problem formulation and discussion
Wittman MD (2018)	Journal of Revenue and Pricing Management	USA	Q2	Definitional framework
Fiig T (2018)	Journal of Revenue and Pricing Management	Denmark	Q2	Dynamic pricing model proposition
Klein R (2019)	European Journal of Operational Research	Germany	Q1	Bibliometric evaluation
Shukla N (2019)	Proceedings of KDD '19	USA		Dynamic pricing model development
Shao S (2019)	Journal of Revenue and Pricing Management	Germany	Q2	Data analysis - statistical regression methods
van der Rest JP (2020)	Journal of Revenue and Pricing Management	Netherlands	Q3	Discussion
Gerlick JA (2020)	Journal of Revenue and Pricing Management	USA	Q3	Bibliometric evaluation
Priester A (2020)	Journal of Revenue and Pricing Management	Germany	Q3	Experimental study
Zhao G (2021)	Journal of Air Transport Management	China		In-person and online survey
Wang K (2021)	Journal of Revenue and Pricing Management	USA		Customer choice model proposal

little consideration for the ancillary services pricing and the need to collect and sort data on the willingness to pay for ancillary services, and a need to introduce personalised pricing of basic, as well as ancillary services. Following sections provide a review of significant research on the assessment of willingness to pay for ancillary services (Section 4), and the personalisation of ancillary services, as well as the integration of the concept of personalisation into existing revenue management systems (Section 5). Section 6 concludes the key findings of this review and provides recommendations for future studies.

2. ANCILLARY SERVICES IN AIR TRANSPORT

One of the oldest forms of ancillary services in air transport is the inflight sale of duty-free products, and for decades it was the only mechanism to generate ancillary revenue. In addition to the duty-free products sale, an example of ancillary services were the so-called penalties, such as charging for excess baggage, as well as cancellation or change of flight. Other services like inflight meals and checked baggage, included in the fare, have traditionally been offered as a complementary service to the basic transport service. Such an offer is called bundling, i.e. combining services with the basic service. Bundling can provide the following benefits to passengers:

- reduction of transaction costs,
- simplification of charging,
- price reduction,
- integration of products and services [4].

In contrast to the above-mentioned practice, low-cost airlines have opted to implement unbundling which they describe as the possibility of giving passengers freedom of choice when choosing ancillary services according to their needs.

Revenues from ancillary services, such as checked-in bags, inflight meals, extra leg room surcharges, assigned seating and inflight entertainment, are ways in which airlines try to cover costs and reduce risks such as fuel price volatility. It is in the segment of ancillary services that airlines, especially traditional and hybrid ones, are becoming more and more innovative.

IdeaWorksCompany has been following airline ancillary services trends since 2007, and every year it publishes a yearbook on ancillary revenue trends comprising statistics on the world's best performing ancillary revenue airlines. According to its latest yearbook [5], ancillary services can be divided into the following categories:

1) A la carte services – the category includes services that passengers can add to their air travel experience. Typical services are inflight meals, baggage service or excess baggage service (that generate extra fees for a passenger), seat selection, call centre support for reservation, service for credit or debit card transactions, priority check-in and security screening, airport lounge service, early boarding, inflight entertainment system services and inflight wireless Internet service.
2) Commission-based services – includes the commission earned by the airline on the sale of hotel accommodation, car rental and travel insurance through its own website, as well as the inflight sale of duty-free products.
3) Frequent Flyer Program – works on the principle of selling "miles" or points to different companies which offer them to customers as incentives to use their services (for example, card companies offer miles or points as an incentive to buy with their credit cards), if those collected miles will be exchanged for air travel [6].
4) Advertising – this category includes any form of advertising in the process of travel. Typical activities are revenue generated from in-flight magazines, advertising in or on an aircraft, air bridges, airport lounges, and placement based on a fee from consumer products or samples.
5) Fare bundles – allocation of a part of the price associated with a product bundle as ancillary revenue. These are mainly services such as checked baggage, early boarding and/or extra leg room.

Some of the more innovative services are also some of the more controversial ancillary services, and include usage of an overhead bin, buying a ticket online and/or web check-in service (even if there is no alternative) and ticket reservation service (from 72 hours to 7 days, depending on the airline) [3].

Over the last decade, revenues from ancillary services have shown an impressive and continuous growth trend. According to IdeaWorksCompany data, *Figure 1* shows an estimate of the trend from ancillary services revenue [3, 5, 7, 8]. Even though there is a huge drop in revenue from ancillary services in year 2020 due to the coronavirus outbreak,

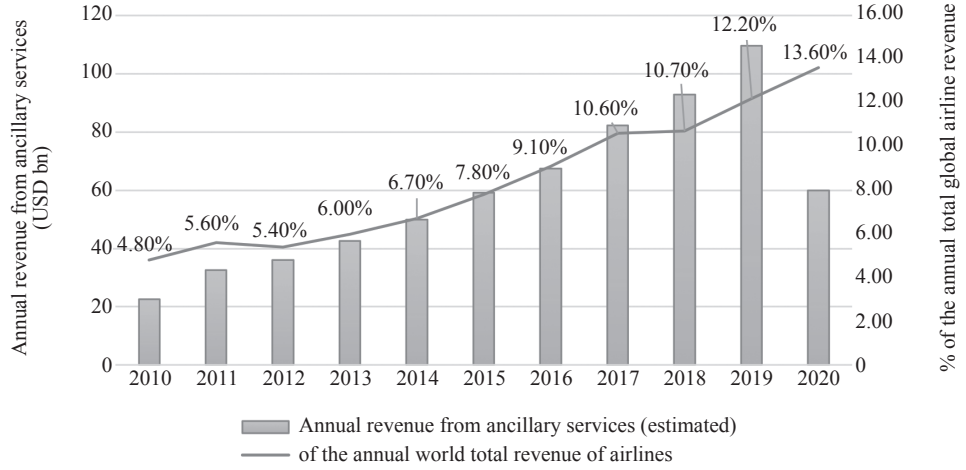

Figure 1 – Estimation of ancillary services revenue trends [3, 5, 7, 8]

the share in total airline revenue did not drop, which indicates significant importance of ancillaries in airline revenue stream.

The coronavirus outbreak in 2020 has deeply affected global air transport. At the worst point of the outbreak, in April 2020, two thirds of the global aircraft fleet was grounded, 90% of operations were cancelled. Previous crises were more geographically and time limited. The biggest change in revenue management systems is forecasting demand – multiple airlines have stopped using historical data to predict demand and are relying more on manual forecasts and new modelling approaches [9]. Opportunities to improve demand forecasting and integrate dynamic pricing are receiving increased attention in post-covid era.

An assessment of results in the 2021 edition of the CarTrawler Yearbook of Ancillary Revenue by IdeaWorksCompany [10] indicates ancillary revenue was the only financial success for airlines in 2020. Although the Covid-19 pandemic reduced passenger revenues by more than 55%, ancillary revenue grew in financial importance and its positive impact provided significant support to air carriers. Key statistic indicator that measures ancillary revenue as a percent of total revenue is improved. Allegiant, Spirit, Viva Aerobus and Wizz Air earned more than 50% of their total revenue from ancillaries. In addition, 50 airlines achieved better ancillary revenue as a percent of total revenue for 2020. For the 75 airlines that provided data, ancillary revenue accounted for 14.6% of total revenue, which represents a 2.5-point increase over the last year. Passengers have shown a willingness to pay for services they believe reduce the risk of Covid-19 exposure, such as front-of-cabin seats to enable quick exit and empty middle seats.

3. PROBLEM DESCRIPTION

The willingness to pay the basic price has been investigated in detail in various professional and scientific publications, but research on how much passengers are willing to pay for ancillary services is very rare. Sabre's global study conducted on travellers from 20 countries [11] in October 2016, based on a pre-defined bundle of ancillary services, such as seat selection, extra baggage and inflight meals, found that passengers would be willing to spend up to 99 USD to personalise their travel experience. The results show that 80% of passengers purchased some form of ancillary service on their last trip, spending an average of 62 USD and are willing to spend up to 99 USD to personalise their trip if it would improve their travel experience. The most sought-after ancillary services are class upgrades, inflight meals, as well as seat selection and extra legroom – all equally with an 11% share, followed by in-flight Wi-Fi (9%) and an extra checked baggage (9%). The popularity of the ancillary service varied among passengers depending on the region they come from: North Americans and Europeans mainly choose seat selection and extra legroom, South Americans opted for in-flight Wi-Fi, Asia and Pacific passengers choose extra baggage, while passengers from Africa and the Middle East choose inflight meals and an accelerated security screening process.

The price of the basic service has been precisely determined for decades through the revenue management system, however little or no consideration is given to the selection of ancillary services and the according pricing of ancillary services. Considering the impact of the allocation of ancillary services from the basic transport service in the air transport industry, as well as the potential of additional revenues from ancillary services, it is logical that airlines consider proposed revenue not only based on the price of basic services, i.e. fare, but also based on the overall potential of ancillary services offered.

Using the principle of differential pricing [1] based on price discrimination (arising from the passengers' willingness to pay for transport services) and product differentiation, airlines segment service demand and generate higher revenues by calculating reservation limits for each booking class throughout the reservation period. But for revenues from ancillary services to be effectively integrated into revenue management systems, the following problem needs to be addressed: how to predict the potential for ancillary revenue before passenger buys a ticket? During the booking process, the optimisation module within the revenue management system for each class calculates reservation limits based on expected ticket revenue and returns seat availability information, all before the passenger selects any ancillary service [12]. Reservation limits are calculated based on the price of the basic service and willingness to pay for the basic service. To include ancillary revenues in the calculation of reservation limits, it is necessary to collect and/or sort data that would provide information on the willingness to pay for ancillary services.

The way in which airlines offer their services and products largely depends on the purchase process itself, which is defined by the possibilities and/or limitations of the distribution systems. Revenue management systems communicate with passengers via distribution systems through a cause-and-effect loop. Airlines upload the calculated reservation limits into global distribution systems which are databases of the availability of possible itineraries. The airlines save and use the passengers' class, price and route data for later calculations of expected revenue for each market in which an airline offers the transport service. Although global distribution systems stood as extremely advanced technology 40-50 years ago, with the occurrence of the Internet and its expansion, certain shortcomings of GDSs were recognised, especially from the perspective of ancillary services integration. One of the GDSs limitation is that the product is reduced to only a few parameters: itinerary, class and the number of available seats on the flight. This prevents airlines from offering ancillary services and products in addition to the basic service. Airlines distribution systems delegate bid creation to GDS, and thus, with losing bid creation control, they also lose valuable passenger data. It is these shortcomings that limit the air transport industry to start applying the principles of modern e-commerce: e-customer relationship management and personalisation of the offer [13]. Just as low-cost airlines recognised the value of Internet sales and e-commerce very early on, traditional airlines have been turning to personalised pricing trends in the last decade, with the support of International Air Transport Association (IATA).

To introduce personalised pricing of basic, as well as ancillary services, it is necessary to comply with two prerequisites: the ability to identify the characteristics of a potential passenger (their status in the frequent flier program, travel purpose and willingness to pay) and the ability to personalise the offer in real time so it could fulfil passengers' needs [14]. If the airlines knew that an individual passenger was willing to pay more for ancillary services, they would have been able to adjust the availability of both basic and ancillary services for that passenger during the booking process.

Frequent flier program could provide quite valuable information on passenger characteristics, however according to Reales and O'Connel [15] the number of active members (members recording some activity in a one-year period) in a global frequent flier program is quite low – results show that on average active members represent only 30% of total FFP members, while some airlines only have 10-20% of active members in their programs. Airlines should motivate FFP members to participate in FFP program more actively through incentives and benefits from it, to increase the usefulness of the data provided through those programs.

Recent improvements in the distribution technology, such as IATA NDC (New Distribution Capability) standard based on the Extensible Markup Language (XML) [14, 16, 17], can replace existing standards to provide feedback between airlines, GDSs and travel agents while distributing airline basic and ancillary services. The NDC standard allows the passengers, if desired, to identify themselves to

the airline so that the airline can use their data when personalising the offer. The airline could then create a special offer for the passenger, tailored to their profile. NDC will enable airlines to dynamically generate and distribute a series of offers in response to each search request. The impending use of these new standards has increased the interest of virtually all industry stakeholders in the development of new mechanisms for dynamic pricing [18]. Ancillary revenue streams were not considered in the original design of today's airline distribution environment. Availability and pricing processes were designed around flight segments, at a time when all available services were entirely bundled within fares. Ancillaries are now an important revenue stream for airlines, and an important value proposition for customers. However, the current state of ancillary product distribution in the industry is an incomplete patchwork, because many of the old booking and ticketing processes were extended to ancillary products as well. With Dynamic Offer Creation concept proposed by IATA [19], flight itineraries and ancillary services may be bundled into offers maximising the contribution for a given customer request.

As airlines have continuously developed revenue management systems in line with trends in the air transport industry, the integration of ancillary revenues into revenue management systems and global reservation systems is a new challenge for the industry.

4. WILLINGNESS TO PAY FOR ANCILLARY SERVICES

One of the first scientific papers on the topic of ancillary services [20] analysed the trend of introducing ancillary services in the United States, for low-cost and traditional airlines. The authors predicted further development of ancillary services in addition to the basic service, but only for the low-cost airlines. Contrary to this view, Allon [21] argues that the separation of ancillary services from the basic transport service, with an emphasis on unbundling the baggage service charge from the basic service charge, is in fact socially acceptable. By applying analytical modelling, he concludes that by introducing extra charging for checked baggage, the airline will change the behaviour of passengers – passengers will choose not to carry checked baggage, thus saving money for themselves and reducing the cost of processing baggage to the airline. On the other hand, it can encourage passengers to carry more hand baggage, and this can extend the duration of boarding, creating delays due to the extension of turnaround time and thus prolongate the departure of aircraft.

The extra baggage service, more precisely the charging of extra baggage, generates significant revenue for airlines. According to IdeaWorks data, revenue from ancillary baggage services in 2018 is estimated at 28.1 billion USD [22]. In a study [23] on the impact of baggage charge on passenger choice of airline, authors analysed data for 2007-2010 period for a set of routes on which low-cost airline Southwest Airlines did not introduce extra baggage charge unlike other airlines on the analysed routes. The data were converted into a set of equations and analysed by the method for estimating a simultaneous system of linear equations – the three-stage least square method (3SLS). Based on the obtained data, the authors concluded that passengers are less sensitive to an increase in the baggage fee compared to the increase of the fare itself, which supports the claim that the allocation of ancillary services from the basic transport service would bring higher revenue to airlines. However, given that the research was conducted during the recession it remains questionable whether the results obtained reflect the real situation or are only a consequence of the recession.

An online survey [24] examined passengers' preferences for the choice of ancillary services depending on the airlines' business model. It was noted that airport parking service and extra baggage service were the most chosen ancillary services, regardless of the airlines' business model. Passengers are more likely to consider purchasing an ancillary service if they choose a low-cost airline. Authors state that such passenger preference is probably a reflection of the image of traditional airlines as more luxurious compared to low-cost airlines. However, the impartiality of the respondents in this survey is questionable given that the respondents participated in the Ancillary Revenue World Conference 2011. The research of ancillary services offer selection [25] was conducted by surveying 249 respondents in the international departure at Zurich Airport, and a choice based conjoint analysis was performed on the attained data. It has been found that economy class passengers see the potential in choosing ancillary services if they provide added value to the travel experience, such as seat selection and airport lounge access.

Rouncivell and others [26] conducted an online survey of 800 respondents in the UK's domestic air transport and used the state preference method on the data obtained to investigate passengers' willingness to pay (WTP) for seat selection. Research indicates that there is a negative correlation between the passengers' price sensitivity of the basic service in relation to the willingness to pay for the seat selection. It can be concluded that the seat selection is a potential source of revenue regardless of the length of the flight. Based on the survey, the authors also noted that the offer of a flight seat selection service could increase the level of satisfaction with the travel experience. The limitation of this research is in the sample of respondents – only UK's domestic air passengers.

From another online survey that studied willingness to pay for various ancillary services, on a sample of 170 respondents from 37 countries, authors conclude [27] that there is significant difference in WTP for ancillary services based on airlines' business model, length of flight and purpose of travel. Significant statistical differences were found for specific ancillary services – passengers value "necessary" services more, such as: inflight meals, extra baggage, priority boarding, as well as seat selection. Leisure passengers on short-haul low-cost airline flights prefer inflight meals. Business passengers on long-haul traditional airline flights choose seats with extra legroom. Authors conclude that passengers attach more value to "necessary" ancillary services (depending on travel parameters) compared to those potentially interesting, but not necessarily required. Although the survey was conducted on respondents from 37 countries, due to the selection of the sample – former students at the University of Cranfield working in the air transport industry – it is not possible to determine the significance of the mentioned hypotheses for all passengers.

Tuzović and others [28] provide insight into passengers' perception and attitude towards ancillary services. The research is based on a survey conducted on 423 respondents, who were offered statements and an appropriate Likert scale for assessing attitudes about each given statement. The research showed that the additional cost due to the ancillary service (which was previously included in the fare) leads to anger among passengers. At the same time, the phenomenon of avoiding airlines which separate the ancillary service from the basic service and charges it additionally is identified. Since the research was conducted ten years ago, it is possible that the passengers' perception has changed due to the commonality of the practice in air transport industry.

Some airlines offer a fare-lock service, or ticket reservation, which allows potential passengers to "lock" the price of the basic service for a while (usually a period of 72 hours to a maximum of 7 days, depending on the airline and the price of the service) until they are sure they will be able to travel on certain dates. In [29], a model was proposed to note key characteristics of the passenger's decision-making process if he is faced with the possibility of choosing a ticket reservation. The authors tested two cases: PO model (partial optimisation model) – fare-lock service is offered, but the price of the basic service is determined by the optimisation module of the revenue management system that considers remaining time and inventory, but does not take into account selected fare-lock service; and FO model (fully optimised model) – fare-lock service is offered, and the price of the basic service is determined dynamically by the optimisation module taking into account the selected fare-lock service. By applying the FO model, the total revenue of the airline can be increased by as much as 37%, and the FO model provides an advantage when the ratio of capacity to demand is higher, or when the airline is under more pressure to sell seats. By testing the PO model, in most cases such a model will bring higher revenues (usually not higher than those using the FO model), but in some cases it can lead to a decrease in revenue (which did not prove to be the case when applying the FO model) if the price of fare-lock is low and the ratio of offered capacities to demand is low. It has been observed that the offer of a fare-lock service also leads to an increase in the number of interested passengers. Reducing the price of a fare-lock service increases the average price of a ticket chosen by passengers. In addition, the free fare-lock option leads to higher total revenue. However, the authors in their calculations assume a monopolised market as well as the so-called "short-sightedness of passengers" – passengers choose the currently offered best option, without considering potential future options. For cases where passengers behave strategically, i.e. calculate the possibility of decrease in basic service price in the future, it would be necessary to integrate game

theory into the model to examine the interaction between passengers and airlines during the reservation period.

Bockelie and Belobaba [30] developed an integrated passenger choice ACM model (ancillary choice model) to explain the process of selection of ancillary services related to itinerary and fare classes. In their model, they divide passengers into classically rational, i.e. simultaneous and boundedly rational, i.e. sequential. Simultaneous and sequential passengers differ in willingness to pay. For sequential passengers only the fare is constrained by WTP. The simulation leads to the conclusion that classically rational passengers will choose an itinerary and fare class in the first phase, and ancillary service in the second phase. By selecting ancillary services in a second phase passengers can alter both the itinerary and the fare class, either as buy-up or buy-down. Boundedly rational passengers bring higher revenues to airlines because they are not affected by ancillary services. The research concludes that ancillary services, as well as passenger behaviour, affect the booking decision and that an ancillary conscious revenue management system may need to account for ancillary-associated behaviour.

Shaw and others [31] assessed the commission-based (third party) ancillaries that passengers are more willing to purchase, in addition to the potential offers that might increase their willingness to pay specific commission-based ancillary services. The study explored commission-based revenue stream from two viewpoints: passengers' viewpoint and an industry viewpoint. To comprehend both viewpoints, authors applied a mixed-method approach and conducted a quantitative passenger survey as well as expert interviews. Their study shows that passengers are willing to pay for specific commission-based ancillary services such as rent-a-car, hotel accommodation and airport parking; and that some promotional offers (future fights discounts) could increase willingness to pay for a certain ancillary service. All nine interviewed experts have outlined the importance of onboard Wi-Fi to boost the sale of commission-based ancillaries during the flight.

5. PERSONALISATION OF ANCILLARY SERVICES

Creating an offer based on passengers information is called offer personalisation [32]. It requires the implementation of two conditions: the ability to recognise the characteristics of the passenger booking the fare and the ability to dynamically adjust services offered in real time to meet the individual needs of the previously identified passenger [14]. Due to recent changes in distribution technology (IATA NDC), which offer completely new possibilities when offering basic and ancillary services [33], the concept of personalisation in the air transport industry has become an unavoidable topic of research in recent years.

The term dynamic pricing is not a new term in economics and operational research, but only with the appearance of new distribution systems, such as IATA NDC, it needs to be defined in more detail for revenue management system application. Whittman and Belobaba [18] define the concept of dynamic pricing in their work, realising after a detailed review of the area that there is no universal definition. Dynamic pricing is a strategy used to determine the price of a product (or service) for different customers at different prices, all based on the set of information available. This information, from a revenue management perspective, may include remaining inventory, the remaining time of the reservation process as well as the forecast of future demand during the reservation process. They can also include specific information about each individual purchase – the characteristics of the request, the choice of ancillary services, willingness to pay, competition etc. Authors propose three different mechanisms of dynamic pricing: assortment optimisation, dynamic price adjustment and continuous pricing. Assortment optimisation is implemented in traditional airline pricing and current revenue management systems. However, the other two mechanisms require the development of new technologies. Dynamic price adjustment and continuous pricing have been infeasible due to the outdated GDS systems. Development of NDC standard that enables the further development and testing of these mechanisms could provide traditional airlines with the opportunity to respond to booking requests in real time. The mechanism of continuous pricing requires a technological pathway to compute, distribute and display the transaction-specific price to each shopping request in real time. For this purpose, it is necessary to improve the logic of pricing within the system, as well as to introduce dynamic pricing of ancillary services [33].

In 2018, IATA issued a white paper "Dynamic Offer Creation" [19] which suggests that revenue management will be more effective when airlines stop separately managing inventory and price. A dynamic offer is created in real time, in response to an individual request. By contextualising the offer of services, i.e. knowing who is behind the individual request, it is possible to harmonise supply and demand, on a personal level. An airline that can assess the opportunity cost and willingness to pay of each passenger is more likely to offer a more attractive range of services to the passenger.

Belobaba and Whittman in their paper [14] research the adjustment of fare class availability after receiving information about the passenger characteristics. In doing so, they apply a simple logic: airlines offer a fare to business passengers, while they offer a lower fare to leisure passengers. The authors propose a simple implementing method of dynamic availability "DynA" by which the airline dynamically adjusts the product offer based on the purpose of the passengers' trip. The simulation determined that in a competitive and stable environment such a simple solution is not satisfactory, given that there is a loss of revenue from business passengers. In the following paper, the same authors [34], aware of the original simplicity of the previously proposed model, introduce two different methods: the "iDynA" class-based method and the "iFDynA" fare-based method. In both methods, it is possible to adjust the availability of offered fares based on the passenger characteristics – business or leisure. Both methods have proven to be effective in increasing yield and revenue for the airline by personalising the offer. The question is: if the assessment of the passengers' willingness to pay could be made more robust depending on the market and time remaining until departure, whether the tested methods would generate revenue and, if so, to what extent. Such an approach would better represent the actual assessment of the passengers' willingness to pay for ancillary services.

Wang et al. [35] introduced a new optimisation approach for the selection and pricing of a la carte and bundled flight and ancillary offers. Their heuristics show how prices of offers that combine flights with ancillary services can be optimised in an offer set, with intuitive results: the price of an offer generally increases with the cost of providing it, as well as the passenger's willingness to pay for it, and the optimal price for one offer depends on the prices of other offers within the offer set. Despite this relative simplicity and intuitiveness, dynamic offer generation is a fundamental change for revenue management. They have proposed a customer choice model that captures the impact of ancillary bundles on flight itinerary choice and then calculates prices for each offer from a continuous range of price points. They have found that in transparent distribution channels an ancillary service should be bundled with the basic service when the estimate for the ancillary is high or when its marginal cost of provision is low.

Madireddy and others [36] see an opportunity to personalise the entire experience: product personalisation, price personalisation, display personalisation and personalisation of navigation through the booking process. The implementation of such level of personalisation would require changes in all platforms included in the passengers' travel experience and is only a theoretical basis for further research into the personalisation of the offer.

Fiig et al. [37] consider that the current principle of revenue management system is inadequate and that the key to profitability is in the implementation of the offer management system (OMS) that enables airlines to dynamically construct and adjust the price of an offer. They also note the importance of upgrading from saving information on a server to the cloud.

Based on passenger choice behaviour, Zhao and others [38] propose a dynamic pricing mechanism of ancillary services. They analyse different ancillary services based on passengers' choice behaviour and propose a dynamic pricing model with predicted choice probability – using binary logic regression to predict the probability of passenger preference for ancillary services. Study was limited in applying linear assumption between the price and choice probability, and study was based on historical data of one flight. More test on more data samples would make data more accurate and reliable.

Klein et al. [32] point out the possibility of integrating analytics and data mining as well as the potential of machine learning as a useful solution for improving revenue management systems. Shukla et al. [39] present and compare three approaches to the dynamic pricing of ancillary services: each approach has a higher level of sophistication of machine learning. Authors proved that a higher revenue from ancillary services can be achieved, by applying dynamic pricing with the application

of machine learning models, and without the use of specific personal passengers' data, or violation of the right to privacy.

The rise of e-commerce, big data analytics and artificial intelligence have influenced pricing and revenue management processes. However, little attention has been paid to ethical and legal concerns in revenue management. Increased use of consumer data and automation is under greater regulatory scrutiny in recent years. Legislators and regulators in Europe tend to limit some recent developments in pricing – especially with regard to personalised pricing [40]. The General Data Protection Regulation (GDPR), which regulates data protection and privacy within the European Union, makes the collection and storage of personal data more restrictive and regulated. GDPR has broadened its scope targeting even foreign companies that collect, use, and save personal data of EU citizens. So, to engage in personalised pricing, an airline must have an explicit consent from the passenger. As personalised pricing relates to price discrimination, fairness and deception, these ethical considerations are often debated [41, 42]. The United States has approached data privacy from a different angle. The Identity Theft and Assumption Deterrence Act of 1998 considers the act of personal data theft, but it depends on a personal complaint and consequential inquiry. Individual states require firms to report security and privacy breaches, however this does not significantly decrease the level of data theft [41]. Nevertheless, the General Data Protection Regulation (GDPR) affect a US website owner (including airlines). They must obtain and store cookie consents from EU visitors, even if the website is based in the US.

Shao and Kauermann [43] propose the application of a statistical regression model and demonstrate how it is possible to interpret individual behaviour based on aggregated data. However, this individual behaviour is difficult to predict and none of the authors in their research state what is the case with passengers who choose certain ancillary services as business passengers in accordance with their needs as business passengers, and when they travel as leisure passengers, they choose other services and have different willingness to pay. Will (and how) the system be able to envision the option of switching from the business passenger category to the leisure passenger category (and vice versa) or will the passenger be permanently assigned with the business (or leisure) passenger characteristic is a challenge for future research.

6. CONCLUSION

Ancillary services and their implementation in revenue management systems is becoming an emerging topic capturing ever increasing attention in air transport industry which is addressed by the number of papers on the subject in relevant journals and publications. This paper provides a review of significant literature on the topic of airline ancillary services for the past decade.

Airlines are becoming increasingly innovative in creating and offering a range of ancillary services, especially because of their potential to generate incremental revenues. As there are significant differences in the passengers' preferences for ancillary services depending on the class, purpose, duration and length of flight, region, and the passengers' willingness to pay, airlines' offer of ancillary services becomes a challenge. When airlines offer ancillary services, an appropriate pricing mechanism should be applied. Personalised pricing of the service requires the ability to identify the characteristics of the potential passengers, as well as their willingness to pay and the ability to personalise the real time offer. However, for this purpose, it is necessary to change the mechanisms of global distribution systems process as well as to improve revenue management systems. Airlines need to develop programmes that engage inactive FFP members more frequently to take advantage of the dataset provided from those programmes – Big Data analytics is a useful tool in obtaining information on a potential passenger.

In terms of methodology of papers regarding willingness to pay for ancillary services, two of the most frequently used methods are surveys and data analysis. However, data used in the reviewed studies might not be relevant anymore. Passengers' perception and willingness to pay might have changed since the data were collected and surveys carried out. Therefore, a new survey and data analysis should be considered in order to obtain more recent information on the willingness to pay for ancillary services. Furthermore, since there is no comprehensive study of all (or at least those most frequently offered) ancillaries, more detailed survey and/or data analysis in order to assess the current passenger's perception and intentions regarding willingness to pay is strongly proposed.

The issue of personalised offers of ancillary services, i.e. how to offer the right service to the right passenger at the right price at the right time, is an important topic of recent work in the field of research. Existing literature on personalisation of ancillaries is mainly focused on new model propositions for implementing ancillaries into existing revenue management systems or improvement of existing systems. There are various proposed models, however some of them remain only theoretical ideas. Future research should provide practical answers on how to incorporate e-commerce principles into existing revenue management systems and present a personalised offer to passengers, while anticipating the variability of individual passenger behaviour. To this end, a more detailed study of the integration of analytics and data mining is needed, as well as the identification of the potential for the implementation of machine learning in traditional revenue management systems.

An important topic of ethical and legal concerns in pricing and revenue management has emerged in recent years. Issues such as (un)fairness, dishonesty, social justice, data privacy, antitrust and discrimination could impact the field of personalised pricing and revenue management for many years to come. The global coronavirus pandemic has had a great impact on air transport, and thus on revenue management. Steep decline in passenger demand and airlines' inability to forecast demand with accuracy have and will have an impact on revenue management and all areas of airline planning and operations linked to it, including ancillary pricing.

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PREGLED IMPLEMENTACIJE DODATNIH USLUGA U SUSTAVE ZA UPRAVLJANJE KAPACITETIMA ZRAKOPLOVA

Dodatne usluge u zračnom prometu predstavljaju skup usluga koje se pružaju putnicima na izbor omogućavajući im unaprjeđenje iskustva putovanja uz akumuliranje dodatnih prihoda zračnim prijevoznicima. Niskotarifni zračni prijevoznici su začetnici tog trenda, ali razdvajanje dodatnih usluga od osnovne usluge postalo je intenzivno rastući trend u industriji zračnog prijevoza tijekom posljednjeg desetljeća. Ova praksa je omogućila niskotarifnim zračnim prijevoznicima da značajno smanje cijenu osnovne usluge. Kako bi ostali konkurentni u eri transparentnosti koju pružaju internetske tražilice, tradicionalni zračni prijevoznici također nude dodatne usluge uz osnovnu uslugu - prijevoz. Kako bi se zadovoljile potrebe putnika, kreiran je čitav spektar različitih dodatnih usluga. Međutim, postojeći sustavi za upravljanje kapacitetima zrakoplova ne uzimaju u obzir i dodatni prihod prilikom izračuna rezervacijskih limita. Kada bi prijevoznik znao da je pojedini putnik spreman platiti više za dodatne usluge, prilikom rezervacijskog procesa bio bi u mogućnosti prilagoditi dostupnost usluge upravo tom putniku. Pregled istraživanja putničke spremnosti za plaćanjem dodatnih usluga prezentiran je u radu, kao i pregled istraživanja personalizacije ponude dodatnih usluga i integracije koncepta personalizacije u postojeće sustave za upravljanje kapacitetima zrakoplova.

KLJUČNE RIJEČI
dodatne usluge; spremnost na plaćanje; personalizirano određivanje cijena; upravljanje kapacitetima zrakoplova; zračni prijevoznici; niskotarifni zračni prijevoznici.

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