Felix Badura

Increasing the efficiency of multi-hub airline networks by means of flexible time-range tickets - An analysis of passenger acceptance, revenue potentials and implications on network design

Thesis

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Increasing the efficiency of multi-hub airline networks by means of flexible time-range tickets

An analysis of passenger acceptance, revenue potentials and implications on network design

Mag. Felix Badura
Vienna, 07.09.2011
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List of Abbreviations

ACA = Adaptive conjoint analysis
ACE = Lanzarote airport
AEA = Association of European Airlines
AMS = Amsterdam airport
API = Application Programming Interface
APU = Auxiliary Power Unit
ARN = Stockholm Arlanda airport
ASK = Available Seat Kilometers
ATO = Assemble-to-order
BCN = Barcelona airport
BRU = Brussels airport
BUD = Budapest airport
CAWI = computer-assisted web interviews
CBC = Choice based conjoint (analysis)
CDG = Paris Charles de Gaulle airport
CoC = Conditions of Carriage
CPH = Copenhagen airport
CRS = Computer Reservation System
DME = Moscow Domodedovo airport
DP = Decoupling Point
EMSR = Expected marginal seat revenue
ETO = Engineer-to-order
ETS = European Emission Trading Scheme
FCO = Rome Fiumicino airport
FFP = Frequent Flyer Program
FRA = Frankfurt airport
FUE = Fuerteventura airport
GDS = Global Distribution System
GPU = Ground Power Unit
HCA = Hybrid Conjoint Analysis
HiCA = Hierarchical Conjoint Analysis
HEL = Helsinki airport
IIA = Independence from Irrelevant Alternatives
IST = Istanbul airport
KUL = Kuala Lumpur airport
LCC = Low-Cost-Carrier
LHR = London Heathrow airport
LIS = Lisbon airport
LJU = Ljubljana airport
LTO = Landing and Take-Off
LYS = Lyon airport
MAD = Madrid airport
MAD = Mean Absolute Deviation
MAPE = Mean absolute percentage error
MCT = Minimum Connecting Time
MNL = Multinomial logit model
MSD = Mean Squared Deviation
MTO = Make-to-order
MTS = Make-to-stock
MUC = Munich airport
MXP = Milan Malpensa airport
NC = Network Carrier
O-D = Origin-Destination (pair)
ODIF = Origin-Destination Itinerary Fare
ODRMS = Origin-Destination revenue management systems
OR = Operations Research
OSL = Oslo airport
PNR = Passenger Name Record
PRG = Prague airport
RP = Revealed Preference
RFP = Restriction free pricing
RM = Revenue Management
RPK = Revenue Passenger Kilometers
SARS = Severe acute respiratory syndrome
SGN = Ho Chi Minh City airport
SOR = Stimulus, organism, reaction
SP = Stated Preference
SVO = Moscow Sheremetyevo airport
TCA = Traditional conjoint analysis
VTTS = Value of travel time savings
VFR = Visiting friends and relatives
VIE = Vienna airport
WAW = Warsaw airport
YM = Yield Management
ZAG = Zagreb airport
ZRH = Zurich airport
Abstract

After the complete liberalization of the airline industry during the 1990s the industry has faced a rapid growth in passenger numbers. This has mainly been caused by the emergence of so-called Low Cost Carrier (LCC) that offer a simplified product (i.e. point-to-point flights without any frills) at a lower cost than traditional Network Carriers. Furthermore LCC also introduced a less differentiated pricing structure (Restriction Free Pricing) which forced competing network carriers to reduce the degree of price discrimination which they were able to practice until then in order to defend their market shares. This has led to a decrease of average yields, which resulted in difficulties for (smaller) Network Carriers to cover their fixed costs, related to the operation of a hub & spoke network. In this environment network airlines are looking for new revenue sources as well as further sources of cost reduction. This development has amplified the consolidation trend of the airline industry and led to the emergence of several multi-hub networks (e.g. Lufthansa runs hub-operation in Frankfurt, Munich, Zurich and Vienna).

One way to leverage the fact that multi-hub networks allow several routings for one origin-destination city pair would be the introduction of flexible tickets, where the actual routing of the passenger is not defined at the moment of purchase but only a certain time prior to departure. This allows airlines to raise the load factor on their network by increasing the degree of overbooking which they currently practice by pooling the risk that more passengers arrive than there is capacity among several flights. Furthermore these tickets might allow network carriers to compete in the low-cost-airline segment without having to further reduce the price level of their regular product (with specified routing).

The present dissertation examined possible designs of such a ticket and their impact on the acceptance by passengers by means of a choice based conjoint study among 356 travelers. The findings suggest that while 77.5% of leisure travelers are willing to accept flexible time-range tickets in their relevant set, only 56% of business travelers are considering using this kind of ticket. More particular the results also showed that business travelers are not willing to compromise on travel duration and departure times, and are subsequently willing to pay a premium for specified tickets. A market share simulation showed that depending on the selected product layout flexible time-range tickets are able to gain up to 60% market share when offered at a discount of up to 33% relative to traditional tickets. When it comes to the actual layout, the largest lever to increase the acceptance is to exclude connection flights from the potential set of flights.

The results contribute to the young research area on flexible products by assessing the disutility which is experienced by customers with regard to particular product characteristics of flexible products. Furthermore the results aim at providing airline managers with a comprehensive overview of the possibilities which flexible time-range tickets bring along when it comes to increasing the load factor and thereby the revenues in a multi-hub network.
1 Introduction

1.1 Current developments in the airline industry

During the last decades the airline industry has been subject to almost uninterrupted growth. This development is based on the fact the industry constantly managed to reduce the costs of service delivery, while at the same time a growing prosperity and therefore higher mobility requirements led to a rise in passenger numbers. Furthermore a range of legal reforms increased the competition and generated further market growth (cf. Figure 1).

As shown above, the number of carried passengers has risen from around 25 million in 1950 to almost 2 billion passengers per year in 2005, which corresponds to a cumulated annual growth rate of almost 8%. Even during the last decade and in rather well-saturated market such as the European Union an annual increase in passenger numbers of around 5% was not unusual.\(^1\)

Although these growth figures would suggest that the airline business is a fairly profitable industry, a look on the overall industry profit shows that this has not always been the case. As shown in Figure 2, the industry has been subject to several crises which have resulted in consecutive losses over a few years. Particular severe events which had a significant impact on the industry were the Gulf war in 1991, the terrorist attacks on the World Trade Center on September 11 (2001) followed by the outbreak of

\(^2\) From 2006 to 2007 the amount of passengers flown within, from or to the European Union even grew by 7.3%, reaching a total of 793 million. Cf. Eurostat (2009), http://epp.eurostat.ec.europa.eu
the SARS influenza in Asia in 2002 and the financial and economic crisis in 2008. Overall, a close correlation between GDP and air travel can be observed, in so far as a 1% change in GDP results in a change of up to 2.5% in the same direction in the demand for air travel.³

Besides these events which had a strong impact on passenger numbers, airlines, as shown in Figure 3 and Figure 4, also have to cope with two other negative developments that strongly influence their bottom line and will be discussed in the following; a significant decrease in fare levels (yield) as well as strong increase in the price for kerosene.

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³ Cf. Airbus (2009), p. 36
⁴ Compiled by the author based on IATA (2009), www.iata.org; Pompl (2007), p. 8
1.1.1 High cost pressure due to the development of fuel prices and the inclusion of aviation in the European Emission Trading Scheme

In 2008 the price per barrel of jet fuel (kerosene) has reached its all-time high of 180 US dollar per barrel. Within only four years the price thereof had more than quadrupled. Although the price for jet fuel has lately decreased to 87.5 USD per barrel (average price for 2010, as at 22.01.2010)\(^7\) due to the economic crisis it is improbable to assume that it would stay at this level after the economy recovers.\(^8\) The resulting need for fuel efficiency is furthermore amplified by the fact that air transport is getting under scrutiny for its impact on greenhouse gas emissions.

Based on the figures for 2006, the transport sector is made responsible for 24% of EU27’s greenhouse gas emissions, with aviation alone accounting for 2.9%.\(^9\) While these figures would suggest that aviation is not the first issue to tackle for policymakers aiming at a reduction of greenhouse gas emissions, this impression changes if growth rates are taken into consideration. Within 16 years (1990-2006) greenhouse gas emissions from civil aviation have increased by 89% (cf. Figure 5)

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\(^5\) Cf. Energy Information Administration (2009), tonto.eia.doe.gov  
\(^6\) Cf. Air Transport Association of America (2009), www.airlines.org; Yields were computed from passenger revenue and mileage data provided by the U.S. Department of Transportation. The portrayed yield was adjusted for U.S. inflation terms.  
\(^7\) Cf. IATA (2010), www.iata.org  
\(^8\) Cf. IATA (2010), http://www.iata.org; Since – in contrast to similar products such as diesel - there is no taxation on kerosene the price correlates more directly with the underlying oil price, which also results in (relatively) more severe price fluctuations in comparison to car fuel prices.  
\(^9\) Cf. European Commission, DG TREN (2009), http://ec.europa.eu; This figure is also in line with the IPCC estimate regarding the global aviation industry (3%). Cf. IPCC (2008), p. 331
As a reaction to this development the European Parliament has in July 2008 adopted a directive by the European Commission which includes the airline industry into the European Emission Trading Scheme (ETS) by January 2012. Following a “cap and trade” approach, airlines will in the first trading period (2012) only receive allowances for 97% of the greenhouse gas emissions caused by the sector in a reference period (average year based on the years 2004-2006). Out of these allowances, 85% will be distributed for free based on the traffic share of airlines in the reference period, while the remaining 15% will be auctioned. Based on the directive, the amount of allowances as well as the share of auctioned certificates will be continuously evaluated and most probably also adjusted (to the detriment of the airline sector) in the period after 2012 in order to decrease the environmental impact of aviation. The IATA estimates an additional cost burden of € 3.5 billion in 2012 as a result of the inclusion of aviation in the European Emission Trading Scheme. If in the long run (e.g. 2020) all certificates will be auctioned, annual expenses to cope with the regulation are expected to increase to up to € 12.8 billion.

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10 Cf. European Commission, DG TREN (2009), http://ec.europa.eu
12 Cf. Ezard (2008), p. 75
<table>
<thead>
<tr>
<th>Measure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of right sized airplane</td>
<td>Due to differing landing &amp; take off consumptions as well as different en-route consumptions per passenger, various aircraft types are more or less efficient in serving specific route lengths. For instance on short routes, the use of turboprop aircrafts is often more fuel efficient than the use of jet airplanes.</td>
</tr>
<tr>
<td>Installation of winglets</td>
<td>So called winglets are blended extensions of the wing which aim at a reduction of air turbulences that can result in fuel savings of up to 3%. Winglets are already standard equipment of most new aircrafts, but are also largely refurbished to existing aircrafts.</td>
</tr>
<tr>
<td>Single-Engine Taxi</td>
<td>Only one engine is used to move an aircraft from the runway to its parking position (and the other way round).</td>
</tr>
<tr>
<td>Weight reduction</td>
<td>To save weight airlines can use lighter aircraft interior equipment (less catering, lighter chairs,...), remove paint from aircraft hull and take only required fuel on board (e.g. by selecting the closest alternate airport as a basis for the fuel reserve calculation). This is also reflected in the massive use of carbon elements in new aircrafts such as the Boeing 787 or the Airbus A350.</td>
</tr>
<tr>
<td>Flight route optimization</td>
<td>By carefully planning the right flight altitude (lower consumption on cruising altitude) as well as cruising at the right speed airlines can reduce consumption. A large lever is also seen in a standardization of the European Air Traffic Management (&quot;Single European Sky&quot;) which can lead to more direct flight routes and less holding patterns.</td>
</tr>
<tr>
<td>Use of ground power unit</td>
<td>Instead of generating its own power on the ground by using the Auxiliary Power Unit (APU), fuel can be saved by relying on a Ground Power Unit (GPU) that is provided by the airport.</td>
</tr>
<tr>
<td>Continuous Descent Approach</td>
<td>This procedure, which depends on traffic situation at an airport, implies that aircrafts follow a continuous descent from their cruise altitude towards their touchdown on the ground which reduces the required engine thrust.</td>
</tr>
<tr>
<td>Use of most modern aircraft technology</td>
<td>By using modern aircrafts and engines, airlines can significantly reduce fuel burn. For instance, a new Boeing 737-800 with approx. 150 seats by Scandinavian Airlines (SAS) uses 20% less fuel per seat kilometer than a (20 years older) MD-82 by SAS with the same capacity. New technologies that aim at a reduction of fuel consumption include riblet films or open-rotor engines. Furthermore there are currently also various experiments with synthetic fuels (e.g. Gas to Liquid fuels [GtL], hydrogen, etc.) which might lead to a more environmentally friendly fuel consumption.</td>
</tr>
</tbody>
</table>

Table 1: Operative methods to reduce fuel consumption

If airlines want to avoid a decrease of passenger demand as a result of passing through additional costs onto their passengers, they have to search for new cost reduction potentials. Table 1 provides an overview of operative measures that can be taken to reduce fuel consumption, which – with a share of more than 25% of all operative costs – has become the major cost driver of the airline business.

Overall, since 1970 the fuel consumption per passenger-kilometre flown has been reduced by 40%. This development has been amplified by the relatively large price increases for kerosene in the last years, which gave lift to an implementation of a range of fuel saving measures at most airlines. Therefore, it is improbable to assume that savings of similar scale can be realized on the technical level within the near future, which would allow airlines to compensate the additional cost burden that results from the

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14 Cf. IATA (2007), www.iata.org
inclusion of the airline industry to the European ETS. This underlines the pressure for airlines to find new ways to lower the costs per seat in order to stay competitive.

1.1.2 Rising competition intensity and a decline in yields

Besides the impact of rising fuel costs, as shown above, airlines also have to cope with a strong decline in yields due to an increased level of competition in the last decades. This change was first and foremost triggered by the market entry of Low-Cost-Carriers (LCC), as a reaction to the liberalization of the air transport market, which caused traditional Network Carriers (NC) to lower their fares in order to stay competitive.16

LCC specialized on point-to-point routes where they have been able to significantly lower the production cost level by offering a simplified product. As these savings were partly passed on to the customers, LCC managed to expand the market for air transportation by addressing new segments with low fares that could not afford travelling by air before. A survey by the German LCC Hapag-Lloyd Express (now Tuifly) revealed that most of its passenger would not have travelled at all or would have used a different mode of transport without the availability of cheap tickets. Only 37% of passengers have switched within the air traffic market.17 This extension of the addressable market has generated a strong growth in passenger numbers during in the last years, which also resulted in a shift of market shares from Network carriers and charter airlines towards LCC (cf. Figure 13).

![Development of the German air transport market](image)

Figure 6: Development of passenger numbers and market share in Germany (2002-2008)18

This trend can also be seen on a European Level where the market share of LCC is estimated to rise up to 33% or even 37% by 2010. Globally, in 2009 LCC already offered 22% of the total seat capacity (this figure, however, similar to statistics on the passenger

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level, hides the fact that the average flight length of LCC is by far shorter than the one from network carriers, resulting in a lower market share if other metrics such as revenues, available seat kilometers or revenue passenger kilometers are considered). 19

The strong market entry by LCC had a twofold impact on European Network Carriers, which shall be presented in the following section of the introduction:

- First of all, LCCs have entered the market by beating traditional NCs on the price level at their most profitable routes, which in turn forced NCs to lower the exercised degree of price discrimination in their fare structure (cf. chapter 2.5.5 for a more detailed discussion). As shown in Figure 7, revenues within Europe have been subject to a decline of 15% within only six years.

![Figure 7: Yield development geographical Europe (2001 – 2007)](image)

- As a consequence of the decrease in fares, especially smaller carriers were not able to compete on some routes with low yields any longer. However, as the operation of a network is subject to strong economies of scale this has put them at a disadvantage to larger carriers. The result has been a wave of consolidation processes among European carriers that has led to the emergence of multi-hub systems.

### 1.1.3 Airline consolidation and the creation of multi-hub networks

Before the liberalization of the European Airline sector, most countries saw the presence of a dominating national airline. Due to the national ownership and their special ‘political’ importance these airlines were often called “flag carriers”.

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While these airlines prior to the liberalization of the European aviation sector during the 1990s were able to operate under the protective ‘umbrella’ of the transport ministries of their home countries, which had a large influence on capacity supply and fares (both were regulated in the bilateral agreements necessary to open a connection), they often found themselves in a rather poor competitive situation after the liberalization process.22 One central problem was in most cases that former flag carriers operated an over-extended hub & spoke network around their main airport (mostly the capital of their state) and employed too much staff under inflexible contracts. The diversity of the served city-pairs often also resulted in a large variety of required aircraft types, which had a negative impact on staff requirements and maintenance cost structure.23

In order to efficiently operate their hub & spoke network carriers rely on a good yield mix, which results from a sound mixture of local and transit passengers. While the first (residents or visitors of the catchment area of a hub) are usually willing to pay higher fares in exchange for obtaining a non-stop flight to their destination, the latter are required in order to justify higher frequencies and the use of larger aircraft which allow for lower unit production costs. Due to the fact that passengers on transfer routes often have the choice between several carriers that offer an indirect connection via their hub, competition on these Origin-Destination pairs is high and yields are rather low. Therefore, ideally, the share of transfer traffic on each spoke route should not rise to more than 60%.24 When confronted with losses as a result of the increased competition after the liberalization of the European aviation sector, many former flag carriers started

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21 Compiled by the author. Pompl notes that as at 2006, almost all EU states still owned a more a less large share of their respective “flag carrier” (except for the airlines of Belgium, the UK, Finland, Spain, the Netherlands and Germany, which were already mostly privatized at that time). Cf. Pompl (2006), p. 452
to reduce their presence in unprofitable spoke markets by weeding out routes. However, due to the characteristics of a network, these small steps often resulted in a chain reaction, since missing transfer passengers from these spokes also decreased the load factor (and therefore usually also the profitability) of other routes.25

To compensate for these traffic losses and to profit from extended network effects, many airlines have increased cooperation by means of interlining or code share agreements as well as by forming alliances.26 Within alliances airlines do not only profit from operational advantages (such as shared frequent-flyer programmes, increased routes offering, joint sales operations and improved negotiation powers towards suppliers) but can also increase their efficiency by weeding out redundant operations, i.e. deciding that a certain city is only connected through one of several hubs. However, due to risk of a potential alliance break up and the high costs of re-starting a formerly abandoned connection there has been reluctance among individual members of an alliance to give up a connection in many cases.27 Even in this case, as long as there is sufficient demand for two (or more) hub connections to a city, an alliance can still improve their network by streamlining their schedules in order to offer their travelers more frequencies to a destination.28 By offering more scheduled departures than a single airline, an alliance is also able to gain higher customer awareness for certain destinations, which finally also results in a higher attractiveness of the involved airlines.29

In many cases, though, the advantages of alliances are not sufficient to sustain in the market, which has led to a wave of several mergers and acquisitions in the past years. “A merger potentially allows 100% consolidation, while in alliances integration is much more limited. In other words, mergers can better achieve the objective for which alliances were formed.”30 Prominent examples were the merger of Air France and KLM in 2004 or the purchase of Swiss Airlines (2005) and Austrian Airlines (2009) by the Lufthansa Group. In a recent survey among airline executives it was found that 88% expect further market consolidation steps in the future.31 Figure 9 gives an overview of the operated hubs as well as ownership and alliance linkages within the three largest European network carrier groups.

26 Cf. Malanik (1999), p. 85; Malanik, at the time the General Manager Technical & Operation of the Association of European Airlines, even states that network carriers that operate a hub & spoke network and do not belong to any alliance are subject to an ‘existence-threatening competitive disadvantage’. Although there have been earlier alliance attempts (e.g. the Qualiflyer group, including Swiss, Austrian Airlines and Sabena), there has been a rise in importance at the end of the 1990s. For instance, the largest current alliance – the Star Alliance – has only been founded in 1997; Cf. Star Alliance (2010), www.staralliance.com
28 Cf. Iatrou / Oretti (2007), p. 4
29 Cf. Grosche (2007), p. 21
30 Iatrou / Oretti (2007), p. 21
This consolidation among several network carriers, as well as the fact that many European hubs are subject to severe congestion at peak hours (and for instance in the case of London Heathrow often also lack additional space to build additional runways that would enlarge their airside capacity), has led to the emergence of multi-hub networks that are under the commercial control of a single company (cf. Figure 10). The most prominent example in Europe is given by Lufthansa AG that directly operates two hubs in Frankfurt and Munich, and indirectly has strong control over four more hubs (Zurich, Vienna, London and Brussels) that are operated by direct subsidiaries (Swiss Airlines, Austrian Airlines, British Midland and Brussels Airlines). If several hubs of an airline or an alliance are within close proximity of each other (e.g. Frankfurt [FRA] and Munich [MUC] within the Lufthansa network) the presence of alternative hubs at first leads to a dilution of the bundling advantage of a single hub, because several cities will have to be connected from all hubs (with relatively seen smaller aircrafts that result in higher unit costs in comparison to a single-hub connection). However, if an airline manages to coordinate their departure times within several hubs, this can turn into a competitive advantage, since the airline then can offer their transfer customers (who do not live in the catchment area of one of their hubs but have to use a feeder flight to the hub) several different departure times from origin cities which are connected to all their hubs.

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32 Own analysis, as at January 2010. Air Europa is only an associated member of Skyteam.
If the involved airlines of a multi-airline group manage to integrate their yield management systems, this can be used to increase the overall yield by differently pricing separate routing options for one Origin-Destination (O-D) pair that is connected through several hubs, based on the expected demand for each of the involved flight legs. This means that in the short run (few days prior to departure) airlines could use price differentiation to deviate passengers onto flights with a relatively low load factor in order to preserve capacity for expected high-yield passengers on other flights. This could be done more effectively if some already accepted bookings (that were sold at a low rate several months before departure) that block capacity on flights that unexpectedly show more demand from high-yield customers could be shifted to other flights that serve the same O-D pair that are expected to have ample capacity at take-off. This approach is addressed by the concept of flexible time-range tickets that will be introduced further below in the introductory chapter.

33 Own analysis, as at January 2010. Airports are designated using IATA Three-Letter-Codes (see Figure 9 or list of abbreviations for explanation). Air Europas hub in Madrid is assigned to the Skyteam alliance, even though the airline is only an associated member of Skyteam at the moment.
1.1.4 Interim summary of challenges, chances and resulting business opportunities for European network carriers

Since the liberalization of the European aviation sector in the 1990s network carriers are confronted with an intensified competition of their peers as well as from new entrants which operate as Low Cost Carriers. As a consequence, most carriers have reacted by offering more discounted tickets in order to stay competitive, which has led to a strong decline in passenger yields. Therefore, although the overall market size is growing by almost 5% per year, most network carriers failed to generate positive financial results during the last decade (except for 2007 which saw extraordinary high profits on a sector level).

This situation has been aggravated by the fact that fuel costs, which are currently the largest single cost item in an airlines balance sheet, rose by more than 800% within the last 20 years. Aiming at more efficient operations, airlines have already achieved significant fuel burn reductions within the last years. In light of the expected cost increase as a result of the inclusion of the aviation sector in the European ETS by the year 2012, further measures will be required to keep the cost of flying at a level that does not endanger the expected (and, based on already concluded fleet extension programs, also required) market growth.

Furthermore, as the market environment did not allow airlines to pass the incurred cost increase through onto their passengers, many carriers had to reduce their network by cutting unprofitable routes. However, since the quality of a network is decreased with every spoke that is removed, this has put small carriers at a disadvantage in the battle for transfer passengers, which are required to sustain hub operations. As a result, many small carriers have either ceased operations or were taken over by larger airlines.

This consolidation wave led to the emergence of three important multi-hub networks in Europe. These networks allow airlines to streamline their operations and to offer transfer passengers more convenient travel options. One potential that has hardly been tapped by airline groups in a coordinated and large-scale manner, though, is the leverage of multi-hub networks in their product and yield management policies in order to achieve a higher load factor and therefore lower, more competitive unit costs. This issue will be addressed with the concept of flexible time-range tickets that are going to be presented in the following chapter.
1.2 Introduction to flexible time-range tickets

Where a spoke airport (i.e. a non-hub airport) is connected to several hub airports, this usually allows for several possible O-D routings. For instance on the route from Bucharest (Otopeni Airport) to Gothenburg (Landvetter Airport), the Star Alliance booking tool shows 30 different daily connections, involving up to two changes and a travel time (not including the way from or to the airport and possible check-in waiting times) between 4:55 and 7:55 hours.
<table>
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<th>Arrival</th>
<th>Travel time</th>
<th>Stopps</th>
<th>Flight numbers</th>
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<td>05:30</td>
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<td>LH3425 / LH3050</td>
</tr>
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<td>07:10</td>
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<td>OS790 / OS303 / SK1444</td>
</tr>
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<td>LH3421 / LH386 / LH3064</td>
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Table 2: Daily Star alliance flights between Bucharest and Gothenburg

In the process of capacity planning and price setting, the expected demand for these routings (and the involved flight legs) is already taken into consideration on an individual level, however, airline alliances usually only show a very low level of integration with regard to Yield Management.36 Even if Yield Management (for instance in an airline group) is done in a coordinated manner by deviating low-fare booking requests onto

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36 Cf. Vinod (2005), p. 68ff
flights with sufficient ample capacity through price differentiation, this approach is still subject to the risk of a poor forecast quality. Since it is – especially if the forecast horizon is very long - more difficult to forecast the demand for a certain booking class on a particular day on a specific flight instead of only forecasting the demand from one destination to another on that day, an airline might accept a low-fare booking request (based on a too pessimistic forecast of business class bookings, which usually occur closer to departure) which then later on blocks a seat that might still have been sold at a higher rate.

One way to achieve a better distribution of passengers onto several available connections (i.e. direct or indirect flights between the city of departure and the destination) who show different loading factors (based on booked passengers) would be the introduction of flexible time-range tickets. These tickets do not specify the actual flight routing at the moment of purchase and would be sold to time-insensitive passengers at a discount. This concept is based on the idea of supplier-driven substitution and has already been applied on an abstract level by scholars from the field of Operations Research (OR) to the airline industry. Gallego and Philipps define a flexible product as “a set of two or more alternatives serving the same market such that a purchaser of the flexible product is assigned one of the alternatives by the seller at a later date.”

For a passenger who books a flexible time-range ticket this would mean that at the time of booking, he or she would receive an earliest departure time as well as a guaranteed latest arrival time on the requested day of travel, while the routing would (for the moment) stay unspecified. A certain time prior to the travel day, the passenger would then be informed about the actual routing based on the final passenger figures in the suitable flights on the day of departure. In order to compensate the passenger for the incurred uncertainty this ticket would have to be priced at a discount in comparison to a regular, specified ticket.

With regard to the mentioned example Bucharest – Gothenburg, Lufthansa could for instance build a flexible time-range ticket comprising all or several of the nine one-stop connections of the airline group. By selling this ticket, the airline would be able to win low-fare passengers without having to decide at the moment of purchase to which flight they will actually be assigned to. This assignment would then take at a later time, based on the available seats (based on much more accurate forecasts) as well as the marginal costs of transporting a passenger on the various flights (e.g. additional fuel costs, airport charges). For the passenger such a booking could look as described in Figure 12).

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37 Cf. chapter 3.3.2 for an extensive discussion of forecasting implications.
38 Cf. Müller-Bungart (2007), p. 113
The rationale for the introduction of such a ticket from the airlines perspective would be twofold. First of all, by not having to specify the routing of discount tickets at the time of purchase, airlines could flexibly shift passengers to alternative flights with ample capacity if there arises unexpected demand with a higher willingness to pay for the foreseen direct flight (that otherwise would have to be rejected). Furthermore the introduction of flexible time-range tickets could allow network airlines to effectively compete against Low Cost Carriers by offering discount tickets, without risking to cannibalize revenues, which might occur if products that are possibly also suitable for customers with a higher willingness to pay are sold at a discount (as it is currently done by discounting non-stop flight tickets). The underlying assumption is that while the incurred uncertainty is unacceptable for business travelers, current LCC customers would be willing to accept possibly longer travel times, because due to the fact that LCC often deserve remote secondary airports (e.g. Bratislava airport instead of Vienna airport), compound travel times are even today of the same length as indirect connections from network carriers.

1.3 State-of-the-field and examined research questions

1.3.1 Research gap and aim of the thesis

As the previous chapter has indicated, the topic of flexible products in the airline industry touches several research areas (cf. Figure 13).

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40 Own illustration (fictive price value, schematic illustration).
While the field of Yield Management has been subject to extensive research since the 1970s, the presence of routing alternatives has only been considered within the last decade. In 2001, Talluri has proposed a model for yield management that simultaneously incorporates seat inventory control and passenger routing. In 2004, Gallego and Philipps were the first to investigate the use of flexible products in a network environment. Using Linear-Programming they demonstrated that flexible products can be a viable mean to induce further demand and without cannibalizing revenues. However, they point out, that the an airline that introduces such a ticket type has to carefully select the right discount, as a too small discount would not be sufficient to induce further demand, while a too large discount would risk a cannibalization of other ticket revenues.

Three years later, Müller-Bungart has published a comprehensive overview over several potential application fields for flexible products. Although the focus is laid on the broadcasting industry, also an introduction regarding an application in the airline industry is given. First of all, applications from the field of air cargo are looked at. The focus on this sector can be explained by the fact that (unless there is a particularly short timeframe for delivery) cargo is insensitive to waiting times and additional handling activities. It can also easily be offloaded in case of oversales and can be transmitted using a different routing than originally planned.

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41 Cf. Talluri (2001), p. 102
In 2008, Gönsch et al. looked at the revenue impact of flexible tickets using an OR-model. In particular, the impact of various assignment moments was examined. The main outcome was that a delayed assignment of passengers allows for an increase in overall revenues (cf. Figure 14).

![Figure 14: The impact of the assignment point of flexible products on revenues](image)

This is mainly driven by the fact that the later the assignment is done, the more accurately an airline knows the demand as well as the no-show-rate for specific flights. It is unclear though, why Gönsch et al. have refrained from considering the case where the assignment is done on the departure day. Lately the topic of flexible tickets has also been adopted from marketing researchers in an overview article. Besides presenting examples from the tourism as well as the airline industry an article by Mang and Spann has focused on raising the question, how these tickets shall be designed in order to remain explainable and graspable for customers.  

However, at the moment there is no comprehensive work that treats the topic from a sales as well as an operations perspective. Furthermore, while most researchers have looked at either various flight dates or several departures per day as flexible components, the option of flexible routing has not been sufficiently covered. Therefore the aim of this dissertation thesis is an evaluation of the concept of flexible time range tickets in a multi-hub network. In particular, the following aspects shall be considered in sequential order:

- Passenger acceptance and its determinants,
- revenue potentials and
- implications on airline hub-design and flight schedule.

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44 Gönsch et al. (2008), p. 18
45 Mang / Spann (2009), p. 638ff
Only with a precise knowledge of the attainable market share for such a product, predictions regarding the potential revenue can be made. As preceding research points out, the take-up rate of flexible tickets strongly depends on the discount which is granted in comparison to regular tickets.\textsuperscript{46} The grantable discount rate in turn depends on the incurred marginal passenger costs of the most probable routing (or a probability-weighted average cost) as well as the behavior of existing passengers (as an airline wants to avoid cannibalization of revenues). Only if these open issues are answered the implications of flexible tickets for airlines on the revenue side as well as regarding their network design can be addressed. The thesis thereby aims at exploring the resource pooling and cost saving potential of flexible tickets within the airline industry. Besides a theoretical contribution the thesis also aims at bridging the gap between existing theoretical approaches and practical applicability of this concept. As Norton, having examined the dissemination of selected innovations in the transport industry, argues, “research in order to improve [the] ability to forecast innovations and their impact is necessary. […] Innovations result from a desire to participate in lucrative traffic. When the market is worthwhile, the carriers will make efforts to tap it.”\textsuperscript{47}

1.3.2 Research questions

Figure 15 shows which research questions will be addressed by this dissertation and which methods will be used to answer them.

\begin{figure}[h]
\centering
\includegraphics[width=0.8\textwidth]{research_questions.png}
\caption{Research questions and methods used to answer them}
\end{figure}

1.4 Structure of the dissertation

After an introduction into the subject and the presentation of the research questions in the introduction, chapter two provides the reader with an overview of the main airline production schemes and their respective operational characteristics and cost structures. The focus will be laid on network airlines that operate a multi-hub network. In this

\textsuperscript{46} Cf. Gallego / Philipps (2004), p. 321ff
\textsuperscript{47} Norton (1966), p. 40
context there will also be an extensive discussion of current load factor optimization methods, namely yield management and overbooking.

Chapter three introduces the concepts of risk and uncertainty as well as theories which describe how consumers and corporations deal with such situations. The chapter ends with a presentation of postponement-strategies in production companies, since these build on the same principles as flexible time-range tickets, which also delay the assignment of customers to a specific product in order to decrease the involved demand risk.

In chapter four currently used flexible products are presented. Where possible, a detailed description of the service process as well as the passenger response is provided in order to be able to grasp initial empirical evidence on the acceptance of specific product characteristics, which have an influence on the perceived uncertainty. This is followed by a presentation of existing studies about passenger preferences with regard to certain product attributes. Based on these findings, possible product designs for flexible products are displayed in a morphological box and examined, having both the demand side as well as the operational feasibility in mind.

The aforementioned evaluation of possible designs is then, based on the results of a set of qualitative interviews, pinpointed to a set of specific product designs which are evaluated in a quantitative study which is presented in chapter five. To test the acceptance of the emerged flexible product designs, a conjoint measurement survey among a sample of travelers was conducted, during which respondents were confronted with a set of travel options for a determined origin-destination path, with different types of flexible time-range tickets being one of them. The results of this empirical survey were contrasted with results from similar studies to validate the results. Finally, based on the results, revenue implications as well as consequences for the network design are be discussed and recommendations for airline managers are presented.

These chapters are followed by a short summary as well as concluding remarks in chapter 6.
2 The business model of network carrier

In order to be able to estimate the impact of an introduction of flexible time-range tickets in multi-hub networks, it is essential to understand the main characteristics of the business model of network carriers and the corresponding route network and yield management practices. Before focusing on network carriers, this chapter aims at providing an overview of the currently existing business models and their differences. In the following the strengths and weaknesses of the hubbing concept are introduced. Particularly, the impact of the increasing role of cooperation (e.g. in alliances) and consolidation processes on the operations of network airlines is examined. The chapter is closed by a presentation of relevant network carrier flight scheduling and yield management techniques.

2.1 Characteristics of the network carrier business model

With regard to commercial passenger airline operations three business models can be distinguished: network carriers, low-cost carriers (LCC) and charter airlines. While the first two operate scheduled flights that are offered to the broad public, the latter by definition offer non-scheduled services, primarily to touristic destinations. Furthermore, taking a narrow perspective, seats on charter flights are usually not directly sold to passengers but are distributed via tour operators only. However, during the last years the distinction between these models became more and more difficult, and many so-called charter airlines (e.g. the Austrian airlines subsidiary Lauda Air) operate according to a fixed schedule and sell (at least a part of) their tickets via the internet or other channels directly to individual consumers. In the European market, the importance of charter airlines has constantly decreased during the last years, since many of their core routes have been taken up by LCC instead. Within only six years (2002-2008), for instance, the market share of charter airlines in the German market has decreased from 24% to 14%. Based on this decreasing importance and the fact that, from a cost perspective, charter airlines are in many aspects very similar to LCC, the following section will only focus on the two remaining business models, network carriers and low-cost airlines.

48 Some authors also cite regional airlines as a separate group (cf. Kummer (2006), p. 85 or Bieger, T. / Agosti, S. (2005), p. 41). However, since most regional carriers in Europe can only survive by operating feeder flights for network carriers they will not be treated as a separate group in this context.
49 Cf. Kummer (2006), p. 82ff
51 Remarkable differences can only be seen in the way charter airlines distribute their tickets (through intermediaries) and with regard to operations (i.e. charter airlines often only offer seasonal flights, following a more or less regular pattern). Furthermore it should be noted that charter airlines can also offer long-haul flights (which from a cost perspective, are very similar to the operations of network carriers, though). Cf. Cento (2009), p. 21 f
2.1.1 Characteristics and cost structure of network airlines

When, due to the appearance of LCC, the academic literature was forced to once again distinguish various business models in the airline industry, a range of terms has been introduced to designate existing airlines that offered scheduled flights. However, as shown in Table 3, most of these terms are either outdated or misleading. From today’s point of view, the only constant differentiation criterion between LCC and ‘the other business model’ is the spatial and temporal network structure. Therefore in the following only the term network carrier will be used.

<table>
<thead>
<tr>
<th>Currently (mis-)used labels to designate network carriers</th>
<th>Why is it misleading?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Full-Service-Carrier (FSC)</strong></td>
<td>In contrast to LCC (often also called ‘no-frills’ airlines), many network carriers originally offered or still offer more customer service (e.g. catering, lounges, etc.). As a reaction to declining yields in their markets, many network carriers (for instance Austrian Airlines) have drastically reduced their pre- and in-flight catering (on short-haul routes), sometimes even below the level of so-called LCCs (such as e.g. FlyNiki).</td>
</tr>
<tr>
<td><strong>Legacy Carrier</strong></td>
<td>These terms have been used to describe carriers with a long history, in contrast to the new market entrants (LCCs). With Southwest (the first LCC) operating for almost 40 years the age of an airline as such cannot serve as a differentiation criterion anymore.</td>
</tr>
<tr>
<td><strong>Traditional Airline</strong></td>
<td>Flag carrier used to designate an airline that was (at least largely) owned by a state. In the USA, the term was used in a broader sense, also including airlines registered in a country. On the one hand, many former flag carriers have been privatized, thereby being owned by individuals or organizations of several countries. On the other hand, ownership or registration do not imply a particular network structure (e.g. Air Lingus, the Irish flag carrier, is currently operating according to a LCC model).</td>
</tr>
</tbody>
</table>

Table 3: Misleading designations for network carriers that are used in the literature

In the course of this work, a network carrier is understood as an airline that operates the vast majority of its flight to and from one or several hub airports to or from a range of spoke airports in a temporarily coordinated way that allows passengers to make connections between the flights. As will be shown and explained more thoroughly further below (cf. chapter 2.1.2 & 2.2.4), running a hub & spoke network involves substantially higher costs than operating simple point-to-point network. This cost reduction potential gave ground to the emergence of the LCC business model. In order to understand the implications of the operational characteristics of this network type, first an overview of the various cost dimensions of network airlines will be given. Table 4 shows the main

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52 Other scholars (Bieger / Agosti (2005), p. 50) also include a global network as a condition for ‘full service’: “The goal of network carriers always has been to provide global air transport networks with complete service chains, seamless customer care, […] lounges and loyalty programs”. Again, though, there are numerous examples for network carriers that do not fulfill these conditions but still qualify as network carriers.

53 Cf. Metzenbauer (2009), austrianaviation.net

54 Cf. Holloway (2008), 47f
cost categories of airlines according to the ICAO accounting scheme. It differentiates between direct operating costs, i.e. all costs related to the operation of specific aircrafts (that usually also change if the aircraft type is changed), and indirect costs.

### Total cost structure of network carriers

#### Direct operating costs (DOC)

<table>
<thead>
<tr>
<th>Category &amp; (selected) cost components</th>
<th>% of operating costs</th>
<th>Tendency</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Flight operations</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cockpit Crew Salaries</td>
<td>35% (8)</td>
<td></td>
</tr>
<tr>
<td>Fuel and oil</td>
<td>11% (11)</td>
<td></td>
</tr>
<tr>
<td>Airport and en-route charges</td>
<td>7% (7)</td>
<td></td>
</tr>
<tr>
<td>Leasing of aircrafts (and crews in case of wet-lease)</td>
<td>9% (9)</td>
<td></td>
</tr>
<tr>
<td><strong>Maintenance</strong></td>
<td>11%</td>
<td></td>
</tr>
<tr>
<td>Staff costs (technicians)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spare parts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Administration</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Depreciation &amp; Amortisation</strong></td>
<td>7%</td>
<td></td>
</tr>
<tr>
<td>Aircrafts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ground equipment (buildings, etc.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amortisations of crew trainings, etc.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sum DOC</strong></td>
<td>53%</td>
<td></td>
</tr>
</tbody>
</table>

#### Indirect operative costs (IOC)

<table>
<thead>
<tr>
<th>Category &amp; cost components</th>
<th>% of operating costs</th>
<th>Tendency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground stations</td>
<td>11%</td>
<td></td>
</tr>
<tr>
<td>Ground staff</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buildings, equipment, transports</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Handling charges (paid to 3rd parties)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Passenger service</td>
<td>11%</td>
<td></td>
</tr>
<tr>
<td>Flight attendents salaries</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Additional passenger costs (catering)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Passenger insurance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sales</td>
<td>14%</td>
<td></td>
</tr>
<tr>
<td>Sales offices</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commissions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other ticketing costs (e.g. CRS fees)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>General &amp; Administration / other costs</strong></td>
<td>11%</td>
<td></td>
</tr>
<tr>
<td><strong>Sum IOC</strong></td>
<td>47%</td>
<td></td>
</tr>
</tbody>
</table>

**Total operating costs:** 100%

Possible deviations from this structure: 1: Airport charges are often also accounted for in the section “ground stations” 2: Could be counted under “General & Administration” 3: These costs are often also considered in the indirect cost section “ground stations” 4: Flight attendants could also be considered as a share of “Flight operations”.

Table 4: Cost structure of network carriers according to the ICAO-convention

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55 As noted by Doganis (Cf. Doganis (2002), S. 75.), there are no binding, airline industry-wide standards. However, all ICAO member states airlines have to report their financials according to the ICAO reporting scheme. This framework – which allows for international comparisons - will be presented in the following.

Over the last years, network carriers have managed to drastically reduce their indirect costs. Among others, this has been achieved by a cut in the customer service level (both on the ground and in the air), an increase in staff productivity\(^{57}\) and a strong reduction of sales and ticketing costs that was mainly achieved by a growing share of online bookings and a tremendous cut in commissions paid to travel agents.\(^{58}\) On the other hand, as already shown in the introduction, fuel costs have strongly increased, thereby pushing up the importance of direct operating costs from less than 50% in 1996 to 60% in 2006 (cf. Figure 16).

![Figure 16: Share of direct and indirect operating costs of European network airlines\(^{59}\)](image)

Besides the relative changes of the various cost categories, European network carriers have overall managed to reduce their cost level during the last years. Austrian Airlines, for instance, has reduced the Cost per Available Seat Kilometer from 9.8 €-Cent in 1998 by 17% to a level of 8.3 €-Cent in 2005.\(^{60}\) The impetus for these improvements came from the market entry of LCC, who managed to grasp a market share of almost 30%\(^{61}\) of the European market for air transport within only one decade and thereby forced network carriers to react. The factors that enabled LCC to achieve a lower cost level and thereby beat network airlines on the price level will be presented in the following chapter.

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\(^{57}\) From 1999 to 2004, Lufthansa or British Airways for instance have reduced their labor force by 9% and 21% respectively (it has to be noted, though, that in some cases this was achieved by outsourcing activities, thereby only shifting employees to other companies). The output (measured in RPK) was during the same period even increased (Lufthansa: +17%) or at least not lowered proportionally (British Airways: -8%). Cf. Dennis (2007), p. 312

\(^{58}\) While commissions still accounted for 7.8% of the passenger revenue in 1996, within 10 years this figure has lowered to 1.9%. Cf. AEA (2007), p. 8

\(^{59}\) Cf. AEA (2007), p. 8

\(^{60}\) Cf. Austrian Airlines (1999), p. 32 ff; Austrian Airlines (2008), p. 48. After 2005 unit costs have risen again (although being, with 9.4 €-cent per ASK in 2007, still 5% below the level of 1998), which can mostly be attributed to a rise in fuel prices.

2.1.2 The Low Cost Carrier challenge

“In the past year, American consumers have saved an estimated $6.3 billion in airline fares because of the competition brought about by new low cost, low fare airlines. Indeed, there has been a revolution going on in American airline travel.”

Federico Peña, US Secretary of Transportation

The low-cost business model in the airline industry has been introduced in the early 1970s in the USA. Among the most successful of the first LCCs has been the company Southwest airlines, which has also explicitly served as a role model for the current European low-cost market leader Ryanair. After several years as a conventional airline, Ryanair has started to operate as the first designated LCC in Europe in 1994.

By specializing on point-to-point traffic and offering a drastically simplified product LCCs have been able to lower the cost of various product components, thereby achieving an overall reduction of unit costs of up to 57% in comparison to network carriers (cf. Figure 17).

![Figure 17: Relative cost advantage of LCC in comparison to network carriers](image)

Based on this cost advantage, which has largely been passed on to consumers, LCCs have been able to win new customer segments, thereby extending the overall market volume. Despite their poor airport & in-flight customer service quality, LCCs have

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63 Cf. Doganis (2006), p. 150. Michael O’Leary, Ryanair’s CEO is quoted as follows: “We went to look at Southwest. It was like the road to Damascus. This was the way to make Ryanair work.”
64 Cf. AEA (2004), p. 26
managed to be perceived as good value for money, which allowed them to gain an overall market share of approximately 30% in the European market within only 15 years. If the differences in unit costs are compared against effectively sold seats (by looking at the costs per RPK), due to their high load factors, LCCs (e.g. Ryanair) are having a cost base that is up to even 70% lower than selected network carriers (e.g. Austrian Airlines, cf. Table 5).

To better understand the different cost levels, it is useful to distinguish between cost differences that are caused by network and operational characteristics that are inherent to the chosen business and network model as well as cost differences that are solely or at least predominantly caused by factors that are not related to the business model (cf. Table 6).

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66 Based on annual reports by the airlines. Cf. Ryanair (2008), p.3ff; AirBerlin (2009), p. 56ff; Austrian Airlines (2009a), p.32ff; Austrian Airlines (2009b), p.3; Since Ryanair does not publish its average sector length, this value (which is essential to calculate RPK & ASK) was derived from an external source that used flight schedules and official sector lengths: Cf. AnnaAero (2008), http://www.anna.aero.com; RPK = Revenue Passenger Kilometers, ASK = Available Seat Kilometers.
As shown above, the majority of cost saving potentials are not unique to the low-cost carrier model (and the corresponding point-to-point traffic structure) but are rather the consequence of more efficient operations, a reduction in the offered customer service level as well as the employment of cheaper, and more flexibly deployable, staff. In reaction to the market entry of LCC, many NC have successfully adapted their cost base by picking up operational characteristics of LCC. With regard to short-haul aircraft utilization, Dennis, for instance, taking a sample of major European carriers reports an increase in the daily flying time from 7:40 hours to 8:31 hours in the period of 2000 to
2005.\textsuperscript{69} Other measures taken included a reduction of onboard catering,\textsuperscript{70} a smaller distance between seat rows (seat pitch),\textsuperscript{71} the establishment of newly founded subsidiaries with lower staff costs,\textsuperscript{72} efforts to harmonize aircraft fleets\textsuperscript{73} and a strong decrease in sales costs (by selling more tickets via the internet and decreasing commissions paid to travel agents).\textsuperscript{74}

On the other hand, many former LCC have evolved their business model by adding components of network carriers to their product, thereby applying a ‘hybrid’ model. Examples for added components include frequent flyer programs (e.g. AirBerlin or Germanwings), connecting flights (e.g. Southwest or Germanwings), in-flight entertainment (e.g. JetBlue) or the use of GDS-services to sell tickets (e.g. Easyjet).\textsuperscript{75}

Since, based on these developments, NC have been able to narrow the cost difference relative to LCC one could argue that the main difference is constituted by the fact that NC operate a hub & spoke network while LCC operate point-to-point routes.\textsuperscript{76}

### 2.2 The economics of hubbing

As analyzed in the previous chapter, many of the cost differences between NC and LCC are mainly caused or at least influenced by the chosen network structure. The following section therefore aims at a comparison of the advantages and the disadvantages of the hub & spoke concept that is used by network carriers.

#### 2.2.1 Network configurations in the airline industry

The configuration of a network is not only the main differentiation criterion between various business models but also the key determinant of costs and revenues.

> “The network is a key strategic factor of airlines, as it is the main driver for generating revenue and costs as well as source of competitive strength or weakness.”\textsuperscript{77}

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\textsuperscript{69} Cf. Dennis (2007), p. 320. Carriers that formerly had a very poor performance have even managed to increase aircraft utilization by 46\% (Iberia, A319) in the same period.

\textsuperscript{70} Cf. Metzenbauer (2009), austrianaviation.net

\textsuperscript{71} Cf. Spiegel Online (2009), www.spiegel.de

\textsuperscript{72} Lufthansa for instance has outsourced many short-haul flights to its subsidiary Lufthansa Cityline, which pays lower salaries than the Lufthansa Passage business unit, cf. Kolodziejczyk (2008), fr-online.de

\textsuperscript{73} While Austrian Airlines, for instance, in 2003 still operated 15 distinct aircraft types (with Boeing 737-600 and Boeing 737-800 only being counted as one type), the number of aircraft types has been reduced to 11 in 2008. Cf. AEA (2004), p. 51 and AEA (2009), p. 20.


\textsuperscript{76} Cf. Cento (2009), p. 133

\textsuperscript{77} Cento (2009), p. 29
Figure 18 gives an overview of prevailing route and (spatial) network configurations. It has to be noted, though, that these constitute ideal configurations. In reality, often a mix of the presented configurations can be found.

![Possible route and network configurations](image)

Figure 18: Possible spatial network configuration patterns

A formerly very important network structure has been the line network. Due to the limited range of aircrafts in the first decades of commercial aviation, many destinations were only reachable with several en route stops throughout the journey (to refuel the aircraft and load or unload passengers). Since line networks require relatively large station, crew and aircraft expenses and on the other hand incur long travel times for passengers willing to travel the entire line, this network type (especially with more than three airports served consecutively) nowadays became very rare. With regard to European airlines, it can for instance still be found in the case of long-range flights where an additional short leg is added or touristic flights to island groups.

Geographically dispersed point-to-point routes (in a narrow sense) are characterised by not allowing for connections at either end of the route. In practice, however, this route type is often offered around aircraft bases, which leads to a more geographically focused network. If all points (cities) within a grid are directly connected to each other the term grid network is used. Although not being a fully connected grid, the networks of the leading European LCC Ryanair and Easyjet are examples for very dense point-to-point networks, where several destinations are served from different bases by means of a direct non-stop flight. To a smaller degree this can also be observed in the case of Germanwings, where various destinations are connected to all of the company’s four bases in Germany (cf. Figure 19). Since it is rarely the case that there is sufficient traffic

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78 Own illustration, based on Hanlon (1999), p. 83
80 Examples include Lufthansa’s so called 5th freedom flights (i.e. an airline from country A flies to country B and has the right to offer an onward flight to country C) from Frankfurt to Ho Chi Minh City (SGN, flight number 772 as of 2010) or Kuala Lumpur (KUL, flight number 782 as of 2010), both with an intermediate stop in Bangkok (BKK).
81 For instance, passengers travelling from Vienna (VIE) to Fuerteventura (FUE) on the Canary Islands with Austrian Airlines (flight number as of 2010: OS 9201) experience an en route stop in Lanzarote (ACE).
volume between all city pairs, which is the key prerequisite for the establishment of a direct link, a fully connected grid network would in most cases not be feasible from an economic point of view.  

A network where all nodes are linked to a central node is called a hub & spoke network. Apart from this spatial classification, in an airline industry context, another prerequisite for an airport to qualify as a hub is a temporal concentration of traffic. According to the definition of the Association of European Airlines (AEA), at a hub airport “one or several airlines offer an integrated network of connecting services to a wide range of destinations at a high frequency.” Figure 20 shows the network structure of three European Network carriers (the Dutch airline KLM, the Czech airline CSA and the Polish airline LOT) which have built a pure hub & spoke network around their main hubs (Amsterdam, Prague and Warsaw).

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82 Cf. Cento (2009), p. 32
83 Own illustration, based on Dobruszkes (2006), p. 255 and Airline Route Maps (2010), airlineroutemaps.com. In 2010, the network of Ryanair consists of 950 routed that connect 150 destinations. At 37 of these destinations at least two aircrafts are based. In average each of these bases is linked to 26 destinations, which means that roughly 20% of the entire network can be reached with non-stop flights from each of the bases. Cf. Ryanair (2010), www.ryanair.com
84 Cf. Button (2002), p. 179 and Alderighi et al. (2007), p. 546. The latter used network centrality and concentration indices as well as the connectivity ratio (the share of indirect connecting flights to the total number of flights) of networks to compare them. The main finding was that only a temporal differentiation is able to capture the differences between LCC and Network Carriers.
85 AEA (1995), p. 23
However, in order to maintain a competitive situation at spoke airports with high traffic volume to other non-hub airports, airlines in practice often establish so-called hub bypass services, thereby partly diluting the pure hub & spoke structure.\textsuperscript{87}

### 2.2.2 Classification of hub & spoke systems

As shown in Table 7, airline hubs can be classified according to spatial, temporal and organisational and economic criteria.

<table>
<thead>
<tr>
<th>Classification criterion</th>
<th>Hub types</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transport object</td>
<td>Passenger Hub</td>
</tr>
<tr>
<td>Geographic Structure</td>
<td>Hourglass Hub</td>
</tr>
<tr>
<td>Wave Design</td>
<td>Peaked Hub</td>
</tr>
<tr>
<td>Network structure</td>
<td>Main hub</td>
</tr>
<tr>
<td>Share of transfer passengers</td>
<td>Traffic hub</td>
</tr>
<tr>
<td>Complexity and Planning</td>
<td>Complex Hub</td>
</tr>
</tbody>
</table>

**Table 7: Classification criteria for hub airports**\textsuperscript{86}

With regard to the transported objects it is interesting to note that although there are some airports which accommodate both, significant passenger and cargo operations (e.g. Hongkong, Frankfurt, Amsterdam and Paris), in most cases there is differentiation according to the transport good. Both the top ranked airports with regard to passengers (Atlanta) or Cargo (Memphis) are not even within the Top20 of the respective opposite category.\textsuperscript{89} This can be explained by the varying operational requirements of cargo traffic (often night-flights, different space requirements, etc.) as well as by the fact that

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\textsuperscript{86} Own illustration, based on Cento (2009), p32 (as source for KLM network as at 2004); CSA (2010), csa.cz; LOT (2010), www.lot.com

\textsuperscript{87} Cf. Holloway (2003), p. 377. A prominent example are the decentralized operations of Lufthansa. In order to stay competitive against newly established low-cost routes to non-hub cities in Germany, Lufthansa has set up a new organization unit "Dezentral" which operates point-to-point routes from spoke airports (e.g. Stuttgart, Hamburg, Berlin or Hamburg) that bypass their main hubs (Frankfurt and Munich). Cf. Lufthansa (2005), investor-relations.lufthansa.com

\textsuperscript{88} Cf. also Maurer (2006), p. 387 and Burghouwt (2007), p.15

\textsuperscript{89} Cf. Airports Council International (2010), www.airports.org
especially airports that operate close to their maximum capacity often focus primarily on passenger traffic as a key revenue driver while cargo traffic is seen as a subordinated business field.

With regard to the geographic position, hinterland and hourglass (directional) hubs can be identified. While the first one aims at bundling local passengers who are then transported further on long-haul flights (and vice versa), the latter one is used to bundle passengers arriving from one direction, who are then flown further into different cities in the area behind the directional hub (e.g. passengers who arrive from Europe in Singapore and are then flown further to other destinations that are located further east).

Since it is the main aim of a hub to allow its passengers to transfer from one incoming to another outgoing flight, the temporal concentration of flights in so called waves is crucial for its success. As Berdy defines it, “a bank (or a wave) is the combination of arriving and departing aircrafts within a window of time.”\(^{90}\) Many European network carriers operate up to six waves per day on their hub.\(^{91}\) To ensure that passengers (and their luggage) are able to make their connection in time, airlines have to respect a certain Minimum Connecting Time (MCT) when making their flight schedules. At major hub airports, this time ranges between 25 (e.g. VIE) and up to 90 minutes (e.g. Paris CDG).\(^{92}\) Since an aircraft of a hub carrier usually has to wait on the ground until connecting passengers from other (incoming) aircrafts of the same wave are on board, long MCTs also reduce the time an aircraft is actually flying (i.e. its productivity).

In order to improve the productivity of the aircraft, to lower the impact of land- and airside congestion and the resulting delays in the entire flight program and to achieve a more balanced usage of ground resources, several airlines have aimed at depeaking their hub operations. In order to decide which flights can be excluded from the time periods which are supposed to be depeaked, airlines have to distinguish between city-pairs with high transfer volumes and valuable yields on the one hand (so called A-segment) and markets with a low connection share and / or low yields on the other hand (C-segment). After this distinction is made, the schedule of the first group can be optimised with regard to an increased connectivity, while the latter can be deferred to off-peak times (thereby allowing for a higher productivity). Besides this increase in asset and staff utilization, the benefits of this concept, which is often also referred to as ‘rolling hub’, also derive from a reduced air- and landside airport congestion that is reflected in lower operating costs (less fuel costs as a result of requested holding patterns, less taxiing time on the ground) as well as reduced customer care costs (fewer compensation payments, less rescheduling efforts due to missed connections). A successful example for depeaking its operations is American Airlines. At Chicago Airport (ORD) the airline has been able to decrease its staff size by almost 5%, while reducing the required airline fleet by five planes. At the same time, depeaking has even improved

\(^{91}\) Cf. Maurer (2006), p. 405
\(^{92}\) Cf. Vienna International Airport (2006), gb2006.viennaairport.com
the revenue situation, since the share of local passengers has gone up (at the expense of some transfer passenger who apparently did not tolerate the overall travel time increase on selected low-demand origin destination pairs). This shows that depeaking can be a viable strategy to increase the profitability of hub operations, especially if a carrier has to cope with capacity problems at its main hub and has a rather high share of local passengers at the same time (who profit from higher frequencies to main destinations due to the increased aircraft usage).

A special case of depeaking, which at first sight leads to a dilution of the bundling benefits of hubs, is the establishment of a reliever hub. This can be reasonable, if an airline is unable to expand at its main hub airport (e.g. due to a shortage of slots at peak-hours) or if it wants to tap the market potential of a different catchment area by offering a large route network directly from there. In this sense, also multi-hub systems (cf. also chapter 2.4) can be understood as special form of connected reliever hubs.

The size of the local market (catchment area) as such can also serve as a discriminating factor in the classification of hub airports. Bourghouwt differentiates between traffic hubs (that register a share of passengers for whom the hub is either the origin or the destination of their travel of more than 60%) and wayports, i.e. hubs that primarily serve as transfer points.

Most carriers usually stable their aircrafts at their home base, even though this comes at the expense of the last departure wave not having any connection links as well as the first departure bank not having any feeder flights. However, if an airline is not able to address a large population in its catchment area and requires a high share of transfer passengers at its hub, it often stables its short-haul aircrafts overnight at spoke airports (night-stops), in order to allow for an early feeder flight that brings passengers to the hub (cf. Figure 21). This stabling at hinterland airports however comes at the expense of increased crew costs (e.g. lodging expenses) and reduced aircraft usage, since a crew has to observe certain rest periods before they can fly again.

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94 Cf. Burghouwt (2007), p.15. One example for a hub airport with a low share of local passengers would be Zurich, where only 35% of all long-haul passengers are local passengers (cf. Moser (2009), www.zeit.de).
95 Theoretically speaking, this kind of scheduling is only necessary if a continuous wave system is impaired by curfews (night flight restrictions). Within Europe, such restrictions are, however, not the exception but the rule.
Based on the temporal coordination as well as the planning complexity of a hub, a distinction between complex and random hub can be made. While complex hubs are the result of a scheduling and flight coordination process that aims at linking flights so as to allow for a large set of meaningful connections and short transfer times, in a random hub environment connections are only a by-product of a flight planning process that primarily aims at aircraft and crew productivity. While the latter still qualifies as a hub from a spatial perspective, there is only an accidental (random) temporal coordination of flights.  

2.2.3 Advantages of hub & spoke systems

The main advantage for companies that operate a hub & spoke network lies in the over-proportional extension of the network that results from every spoke (destination) that is added to the network (multiplying effect). As shown in Table 8, in order to connect 55 city-pairs, an airline only has to connect 10 spoke airports (designated as n) to its main hub, which requires no more than 20 flights. In a point to point network (without the possibility to transfer between flights) an airline would have to offer 90 flights (n*(n-1)) in order to achieve the same coverage.

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97 Based on Hanlon (2007), p. 187
<table>
<thead>
<tr>
<th>Number of connections (spokes) to a hub</th>
<th>Required flights to operate one wave to / from the hub</th>
<th>Number of city-pairs that can be connected (including the hub as a destination)</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>( n \times 2 )</td>
<td>( n \frac{(n+1)}{2} )</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>10</td>
<td>20</td>
<td>55</td>
</tr>
<tr>
<td>50</td>
<td>100</td>
<td>1275</td>
</tr>
<tr>
<td>100</td>
<td>200</td>
<td>5050</td>
</tr>
</tbody>
</table>

*Table 8: Exponential growth of connected city-pairs in a hub & spoke network*  

The more spokes are already connected to a hub, the larger the amount of additional city-pairs that result from adding an additional spoke. In reality though it has to be noted that due to the fact that some spoke airports might be (too) close to each other or flying from A to B via a hub would incur in unacceptably long travel times in comparison to a direct connection (e.g. in the case of backtracking) not all resulting connections make sense from a passenger perspective.  

Offering a hub & spoke system also allows airlines to profit from *economies of scale*, i.e. a reduction in the costs per produced unit in case of an increase of the overall level of output. In an airline context, cost reduction potentials arise due to the distribution of fixed costs (e.g. airport facilities, general and administration expenses, fixed marketing and distribution costs or fixed maintenance costs) over a bigger number of transported passengers. Furthermore larger airlines (at least with regard to their market share at the hub airport) can also profit from lower purchasing prices due to an increased bargaining power (e.g. with regard to fuel or handling operations suppliers or the home airport as such).  

Network airlines furthermore profit from *economies of scope*, i.e. a reduction in overall costs due to a joint production of a range of services (flights) in comparison to individual airlines that would operate the route network separately from each other. Additionally to this cost reduction effect (sometimes also called ‘economies of network size’), airlines can also draw upon demand economies of scope, which occur if the demand for a range of services is larger than the demand if each of the services would be offered by a separate supplier. This is also reflected in lower marketing costs. If an airline has a significant market share at the local hub and is already present in the relevant set of

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100 Hanlon (1999), p. 84 f. as well as p. 127  
102 This effect can even be amplified by joining an alliance. Cf. Kleyman / Seristo (2004), p. 98  
103 Cf. Button (2004), p.32; Button (2002), p. 180; Iatrou / Oretti (2007), p. 121. This increase in demand is one the one hand caused by the offer of a larger and better integrated route network, but is on the other hand also due to the fact that the resulting lower costs base can – if passed on in the form of lower fares to the passenger – induce additional demand.
potential air travellers, it has a significant advantage in comparison to a new entrant when it opens an additional route.\textsuperscript{104}

**Economies of traffic density** occur due to an increase in the traffic on specific spokes that results from the consolidation of passengers (bundling) in the hub. This increase in the overall traffic volume allows a network airline to achieve higher load factors and to use larger (more efficient) aircrafts on routes which would – if only filled with local traffic – require smaller aircrafts with higher costs per seat (this effect is often also referred to as economics of aircraft size).\textsuperscript{105}

“We the traffic density on a route and the sector length(s) on that route will influence the size and type of aircraft chosen for that route. Aircraft type, and more especially the size of the aircraft, is a key determinant of unit costs. [...] As a general rule, though there are exceptions, the larger an aircraft, the lower will be its direct operating costs per unit of output [...] In other words, other things being equal, the direct operating costs of aircraft do not increase in proportion to their size or their payload capacity.”\textsuperscript{106}

Besides cost advantages related to the operation of the aircraft as such (e.g. required flight deck\textsuperscript{107} and cabin crew or fuel burn do not increase proportionally to aircraft size), this advantage is amplified by the effect that larger planes do not require proportionally more ground handling efforts than smaller ones (e.g. required gate facilities and staff, air traffic management staff, baggage handling staff, maintenance, etc.).\textsuperscript{108} The impact of these advantages on unit costs (costs per seat mile) is illustrated in Figure 22.

\textsuperscript{104} Cf. Hanlon (1999), p. 45
\textsuperscript{105} This effect increases with the number of spoke flights that are consolidated in an arrival and departure wave. E.g. in order to achieve a load factor of 75% (only out of transfer passengers) on a route where an aircraft with 200 seats is used, an airline that operates 25 incoming flights would require six transfer passengers from each route, while an airline that operates 50 incoming flights per wave would only require three connection passengers per route. Cf. Holloway (2003), p. 387
\textsuperscript{106} Doganis (2002), p. 105ff
\textsuperscript{107} In practice, there are several airlines, though, where pilots flying larger aircraft also receive higher salaries (cf. Hansen / Wei (2003), p. 290f). This is on the one hand due to the fact that it is traditionally often rather senior (i.e. more expensive) staff that flies larger aircrafts, while on the other hand, many network carriers have opened separate business units that operate smaller aircrafts with the aim of avoiding to pay newly hired pilots the salary of the main company's flight deck crews (e.g. Lufthansa Cityline pilots earn considerably less than Lufthansa Passage pilots, cf. Kolodziejczyk (2008), fr-online.de; Tyrolean pilots earn approximately 25% less than Austrian Airlines pilots, cf. DiePresse (2007), diepresse.com) These subsidiaries however are often – based on contracts concluded with the labor unions of the main airline – not allowed to operate larger aircrafts.
\textsuperscript{108} Cf. Iatrou/Oretti (2007), p. 125; For example, a Boeing 767-300 can accommodate almost 3 times as many passengers as a Boeing 737-400 but only consumes twice as much fuel as the latter. Cf. Doganis (2002), p. 120
Economies of density in airline markets have been empirically examined by Brueckner and Spiller. Using demand, fare and cost data over a large set of US routes they found a cost advantage of up to 25% per seat mile on high density routes. Besides the already mentioned cost reduction potentials they also quote higher frequencies (which for instance allow for a more balanced usage of staff and airport resources as well as greater aircraft utilization) as a source of savings.\textsuperscript{110} Based on their results they already in 1994 came to the conclusion that “industry consolidation may be the inevitable effect of deregulation.”\textsuperscript{111}

If hubbing enables an airline to offer higher frequencies on a route, this also has a positive impact on the demand for its services, since it increases the likelihood that a scheduled departure matches the expectation of a potential customer, by decreasing the so-called ‘schedule delay’, i.e. the time elapsed between desired and actual departure time.\textsuperscript{112} This is especially true for high-yield business travellers who value the amenities of high frequencies that allow them to react flexibly to changes in their agenda (e.g. take a later flight if a meeting lasts longer than expected). The resulting and so called ‘S-curve’ effect states that an airline can increase its market share by adding additional frequencies to a route disproportionately high (i.e. even more than the mere increase in offered capacity relative to the total capacity on this route would imply). This phenomenon can lead to a trade-off between savings resulting from larger aircrafts and the benefits that occur from offering higher frequencies (with – ceteris paribus – smaller aircrafts). Building upon an air travellers’ choice model, Hansen and Wei even conclude that “airlines have an economic incentive to use aircraft smaller than the least-cost

\textsuperscript{109} Doganis (2002), p. 120
\textsuperscript{111} Brueckner / Spiller (1994), p. 410
\textsuperscript{112} Cf. Hansen / Wei (2005), p. 316
aircraft, since for the same capacity provided in the market an increase of frequency can attract more passengers.\textsuperscript{113} However, while a recent empirical analysis of US-markets has confirmed this relationship on markets where network carriers where competing with each other, it also revealed that the presence of LCC on analyzed city-pairs led to a weakening of the S-curve phenomenon. This is explained by the increased importance of the price as a decision criterion in these markets at the detriment of the importance of the offered frequency.\textsuperscript{114}

To describe a market situation where an airline has a significant market share (Iatrou and Oretti for instance define a threshold value of 60%)\textsuperscript{115} and the remaining market is served by various other (smaller) carriers, the term ‘\textit{fortress hub}’ is used. Such a setting allows the dominant carrier to profit from extensive economies of scale, scope and density on its hub routes which can hardly be met by a new entrant.\textsuperscript{116} Furthermore, slot scarcity (at least during peak hours) deteriorates the chances of market entry by competitors. Even if a competitor enters the stage by opening a new route, the incumbent airline can react by lowering its fares on the selected route in order to keep its market share or to drive a competitor out of the market (so called predatory pricing).\textsuperscript{117}

Furthermore, hubbing also decreases the demand risks on various spokes in comparison to a point-to-point route, since it bundles several Origin-Destination itineraries on a specific flight leg, thereby decreasing the dependence on a particular O&D demand. As Barla & Constantatos specify, “the advantage of hubbing in the presence of demand uncertainty results from the fact that by pooling consumers, the H&S structure offers the flexibility to adjust the allocation of capacity across markets after the demand has been revealed.”\textsuperscript{118}

If an airline enjoys a monopoly-like position at its hub, it can charge customers higher fares on direct flights to and from the hub, which incorporate a so-called \textit{hub-premium}. This premium can (among other factors) be explained by the absence of a strong competitor, the offer of a relatively high service quality (non-stop flights at a high frequency) as well as the value that customers derive from the fact that, thanks to the

\textsuperscript{113} Hansen / Wei (2005), p. 325 or Holloway (2003), p. 442. It has to be noted though that especially at congested hub airports, it is often not possible to add additional frequencies due to slot scarcity.

\textsuperscript{114} Binggeli / Pompeo (2006), p. 2

\textsuperscript{115} Cf. Iatrou/Oretti (2007), p. 129

\textsuperscript{116} Examples for dominant positions are Lufthansa (incl. Cityline) at Frankfurt Airport (who transport 60\% of all passengers), Air France (incl. Regional) at Paris CDG (51\%), KLM in Amsterdam (52\%) or Turkish Airlines at Istanbul airport (74\%, cf. Airline Business (2010b), p. 50f).

\textsuperscript{117} Cf Doganis (2002), p. 257 or Pompl (2007), p. 233 and 440f. Predatory pricing is prohibited in the European Union, however, in practice it is difficult to legally examine whether a discount strategy is a regular competitive behavior or predatory pricing. Convictions in this field are therefore extremely rare and include in Europe for instance the case Germany vs. Lufthansa on the route Frankfurt – Berlin, in which the German anti-trust agency forced Lufthansa to raise its prices above a certain threshold value (cf. Forsyth et al. (2005), p. 176ff).

\textsuperscript{118} Barla / Constantatos (2000), p. 177f
dominance of the hub airline, they can use their Frequent Flyer Program (FFP) benefits on a large set of routes. This reduces the likelihood that a passenger books a different airline, even though it might be cheaper than the dominant hub carrier.\textsuperscript{119} In a recent examination of the US market, it was found that hub carriers are able to charge fares that are 14% higher than those of competitors serving the same route. Of this markup, about one quarter was attributed to the value of FFP-benefits.\textsuperscript{120} The situation at fortress hub and the mentioned hub-premium has regularly been subject to the scrutiny of competition authorities since it is assumed to impede competition. While this might be true for the competition on flights to and from a hub (especially on hubs with a low penetration of LCC), one can also observe an increased competition between hubs with regard to city-pairs that are connected through several competing hub airports.\textsuperscript{121}

2.2.4 Disadvantages of hub & spoke systems

Although hub operations come along with a range of advantages, these have to be weighed against several disadvantages which will be presented in the following in order to evaluate whether a hub & spoke network is a suitable structure in certain traffic situations.

First of all, operating a hub & spoke network results in a relatively large \textit{complexity} which in turn requires not only investments into hub facilities (e.g. transfer desks) and IT-systems but also substantially more coordination efforts, which result in additional staff needs and costs.\textsuperscript{122} In case of highly peaked hub operations airlines also have to cope with the fact that staffing has to consider peak-hour demand rates, which results in a low productivity in off-peak hours. Furthermore the increased complexity also increases the likelihood of errors, for instance with regard to luggage handling, where the transfer of baggage from one aircraft to another accounts for 52% of all mishandled bag incidents. As a result, while at a global level only 1.1% of all passengers do not find their luggage in time at the destination, this figure raises to up to 2.8% at some European network carriers (e.g. British Airways), which leads to additional handling costs.\textsuperscript{123}

To ensure a high connectivity, an airline first has to design its network, and must then schedule and synchronize the resulting amount of flights. This process includes the consideration of slot, aircraft and staff requirements, as well as an estimation of the attainable demand and the respective yield on all origin-destination pairs that are affected by a certain scheduling decision (cf. also chapter 2.4), making it a much more

\begin{itemize}
\item \textsuperscript{119} Cf. Hanlon (1999), p. 174
\item \textsuperscript{120} Cf. Lederman (2008), p. 63
\item \textsuperscript{121} Cf. Hanlon (1999), p. 175
\item \textsuperscript{122} Austrian Airlines for instance operates a Hub Control Center at Vienna Airport that comprises about 30 employees (cf. BörseExpress (2005), www.boerse-express.com).
\item \textsuperscript{123} Cf. AEA (2009c), www.aea.be; Data from Q1 2008. At the end of Q1 (27.3.08) British Airways moved its flights to the new Terminal 5 at Heathrow airport, which has caused a lot of initial luggage problems. Although this worsens the statistics, the value is in line with the value from Q1 / 2007 where 2.5% of all bags were delayed. The overall volume-weighted AEA average is 16 mishandled bags per 1000 enplaned passengers. Causes for mishandled baggage are found in SITA (2010), p. 5f.
\end{itemize}
expensive task than the comparably simple scheduling process of Low-Cost-Carrier.\textsuperscript{124} Moreover, since aircrafts have to wait for connecting flights, they achieve much lower utilization rates as compared to the continuous operation schedule of LCC. In 2004, for instance, aircrafts of the leading European LCC Ryanair, easyJet and Norwegian have in average been in the air for 11 h per day, while the airplanes of the network carriers British Airways or SN Brussels Airlines have only flown for 9,2 and 7,7 hours respectively.\textsuperscript{125}

Since a hub & spoke network substantially relies on allowing passengers to connect between flights, it is highly sensitive to delays, which can either be caused by congestion of land- or airside airport facilities (e.g. long queues at security checkpoints or tight runway capacity) during peak hours or flight disruptions. A major source of airside congestions are Air Traffic Control (ATC) delays, which are caused by a congestion of flight routes and approach paths and force aircrafts to fly holding patterns prior to landing (or – in the case of departing aircrafts - wait on the ground) in order to obtain a free slot. This problem intensifies, if irregular conditions (e.g. runway closure, bad weather, etc.) decrease the allowed air traffic flow rate below normal levels. While disruptions in other types of networks often only affect a small part of it, irregularities within a hub & spoke system can affect the entire operation due to so-called ‘knock-on’ effects (sometimes also referred to as ‘propagated delays’). This is on the one hand caused by the fact that a flight uses several resources (i.e. cockpit crew, cabin crew and aircraft)\textsuperscript{126} which are possibly foreseen to be used on multiple onward flights of the hub carrier, while on the other hand formerly unaffected flights might also be held back intentionally in order to allow delayed connecting passengers to reach it.\textsuperscript{127}

\textsuperscript{124} Cf. Holloway (2003), p. 295
\textsuperscript{125} Cf. Dobruzkes (2006), p. 250
\textsuperscript{126} Since safety regulations require crew members to observe rest times after a certain duty time, excessive delays may force an airline to call in replacement crews to operate onward flights.
Flight delays at European Hub Airports

Figure 23 shows the percentage of delayed flights at European Airports. Overall, around 24% of flights have departed with a delay of more than 15 minutes (in average 42 minutes). In the comparison of different airports it can be seen that due to the presence of coordinated arrival- and departure waves, which often pass on potential delays from one flight to another, especially hub airports with a high share of transit passengers (e.g. Frankfurt: 53%, Amsterdam: 42%, LHR: 35% and CDG: 32%) are subject to delays.129

When examining those delay figures, one has to keep in mind though that many airlines deliberately plan longer block times130 in order to improve their on-time performance and the stability of their waves with regard to disruptions. This practice, which is often called ‘padding’ or ‘buffering’, however decreases the attractiveness of certain connections to passengers (due to longer overall travel times) as well as staff and aircraft productivity.131

Besides the lower productivity (due to lost time) delays also result in high costs due to additional fuel burn (e.g. because of holding patterns in the air or longer taxi times on the ground) as well as rescheduling and compensation costs of passengers in case of excessive delays or missed connections.132 On a European level, in 2008 ATC-delays

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128 Cf. AEA (2009a), www.aea.be
129 Cf. Fraport AG (2009), www.ausbau.fraport.de
130 Block time is the time after the aircraft has left its parking position at its departure airport (‘off-blocks’) until it has again reached its parking position at its destination (‘on-blocks’).
132 Cf. also Table 14 for an overview of required compensation payments in the EU and the USA.
alone have resulted in costs of around € 900 million.\textsuperscript{133} On an individual airline level, Austrian Airlines, for instance, has incurred overall delay costs of approximately € 30 million in 2005.\textsuperscript{134}

Since hub & spoke networks do “break-up” itineraries they also have a twofold impact on operational costs. First of all, since the hub in most cases is not located in the middle of the journey between two cities, flying via a hub leads to \textbf{detour in comparison to a non-stop flight}. A passenger who, for instance, flies from Vienna to Riga via Frankfurt travels 624km on the first and 1.275km on the second flight leg, thereby covering a total distance of 1.899km. This is 73\% more than a passenger who takes a direct flight to cover the 1.100 kilometer between the two cities.\textsuperscript{135}

Second, the negative impact of an indirect itinerary is further amplified by the fact, that aircraft and crew operating costs do not grow proportionally to the distance travelled. In other words, as shown exemplarily with regard to the fuel costs of a Boeing 737-400 airplane in Figure 24, \textbf{the shorter a flight, the higher are its direct operating costs}. This is among other factors caused by the fact that an airline always requires to take-off, climb, descent and land, causing a fixed cost burden, irrespective of the time an airplane spends in the cruise stage of the flight (with comparably low fuel burn). As can be seen, fuel costs on a flight over 463km (e.g. Vienna to Belgrade) amount to € 1.168, while the cost of fuel on a flight that covers twice the distance (i.e. 926 km, e.g. Vienna to Bruxelles) are only 59\% higher (€ 1.861).

\textsuperscript{133} Cf. Eurocontrol (2009), p. 10
\textsuperscript{134} BörseExpress (2005), www.boerse-express.com; This number does not include the damage to the company’s reputation, which might also have a negative long-term effect on revenues.
\textsuperscript{135} Cf. Great Circle Mapper (2010), www.gcmap.com
In addition, since airplanes only operate close to their maximum speeds when flying at cruising altitude, short flights also lead to lower average speeds, thereby decreasing the productivity of the aircraft as well as the flight crew (when expressed as output or costs per flown kilometer).\textsuperscript{137}

Finally the fact that a connection via a hub requires an additional LTO-cycle affects airline costs by raising the share of fixed costs per flight (e.g. aircraft-related airport charges, air traffic control charges related to take-off and landing or cycle-driven maintenance costs)\textsuperscript{138} and requiring the airline to pay additional marginal passenger-driven flight costs, e.g. catering or \textit{passenger-related airport fees}.\textsuperscript{139}

\begin{figure}[h!]
\centering
\includegraphics[width=\textwidth]{fuel_costs.png}
\caption{The impact of flight distance on fuel consumption\textsuperscript{136}}
\end{figure}

\textsuperscript{136} Own illustration, based on European Environment Agency (2007), p. 24 (fuel consumption values) and IATA (2010), www.iata.org (average fuel price for 2010, as at 22.01.2010). The costs of the LTO-cycle (€425) can be subdivided into taxiing out (22%), take-off (10%), climb (27%), descent (18%) and taxiing in (22%). Climb designates the flight from 3.000 ft (boundary of the LTO cycle) to cruise level (starting at 31.000 feet). Descent is the flight from cruising altitude until an altitude of 3.000 feet (approximately 1.000 meter) is reached.

\textsuperscript{137} Cf. Holloway (2003), p. 370 f. Overall, the unit costs per ASK are, for instance on short flight of 500km with an Airbus A321 up to three times higher than on a long flight (3.500km) with the same type. Cf. Doganis (2002), p. 131

\textsuperscript{138} Since legally required maintenance checks are either triggered by a certain number of flight hours, a certain time interval since the last check or a certain amount of flight cycles (usually following a ‘whichever comes first’ approach), carriers with short sector lengths are subject to relatively higher maintenance costs. Cf. Doganis (2002), p.93.

\textsuperscript{139} At Vienna Airport for instance, the handling fee per passenger amounts to €15.52. However, to attract transfer traffic through Vienna, in case of transfer passengers the fee is lowered by €8. Cf. Vienna International Airport (2009), p. 8f
2.2.5 Implications for intra-continental hub & spoke operations

Offering intra-continental connections via their hub allows airlines to connect destinations with each other that do not show enough passenger demand to allow for a direct connection at reasonable prices. However, in case passengers also have the choice to select a direct flight (e.g. offered by a low-cost carrier), a connection via a hub is not only disadvantageous for the airline (due to an additional LTO-cycle, a longer flight distance and a reduced stage lengths) but is also considered inferior by the passenger due to longer travel times and the need to change flights at the hub. This leads to the dilemma that hubbing leads to an increase in costs in conjunction with a lower perceived customer value and thereby also a lower achievable yield.

While until the liberalization of air traffic passengers often had no alternative to the connecting services of a network carrier in order to fly to a less demanded destination, this has changed with the growing offer of non-stop flights by LCC that due to the rising competition on trunk routes, now often already cover less demanded routes in their network (e.g. Ryanair offers direct flights from London to 16 cities in France, of which only one has a population of more than 500 thousand inhabitants).

Apart from the resulting yield decrease for economy-class fares, European network carriers also suffer from a strong decline in the share of premium passengers on intra-continental routes. While the amount of premium passengers on intercontinental long-haul flights has been almost constant, the share of business-class passengers has decreased from 18% in 2001 to only 10% in 2007 (cf. Figure 25). In the light of tighter corporate travel budgets this trend has even been amplified by the global economic crisis in 2009. For this year, Austrian Airlines, for example, reported a share of business class passengers of only 8.9% on flights to Eastern Europe, which are primarily targeted at business passengers.140

140 Austrian Airlines (2009c), www.aua.com
Based on these figures and the increasing competition intensity, it is not surprising that intra-continental routes often do not generate sufficient revenues to sustain hub & spoke operations, but do rely heavily on the yields from intercontinental routes.

“Time and again, network carriers have shown they can’t make money from short-haul operations and are being upstaged by more efficient low-cost players. Put simply, the core network airline skill is in delivering – and making money from – the complexities of a mixed class long-haul product.”

Having analyzed the profitability of different traffic segments of European network carriers, Auerbach and Delfmann identify traffic to or from the hub, traffic from non-hub cities to inter-continental destinations and – to a smaller extent - decentral intra-continental traffic (that bypasses the hub) as the most profitable ones. This is in line with the results of an analysis of British Airways that highlights the importance of (especially long-haul) traffic that originates and ends at the airlines hub and clearly identifies short-haul connection traffic as the least profitable business segment of the carrier. This finding is also confirmed with regard to the overall situation of European network carriers as portrayed by the statistics of the Association of European airlines. While traffic from or to the Northern Atlantic as well as the Sub-Saharan part of Africa has resulted in positive operating ratios in 2006, traffic within geographical Europe has in average only covered 98% of its expenses and has therefore been made accountable for losses of € 355 million within one year (cf. Figure 26).

\[142\] Airline Business (2010a), p. 50
\[143\] Cf. Auerbach / Delfmann (2005), p. 76
\[144\] Cf. Taneja (2002), p. 53
\[145\] In its publications the AEA defines operating ratio as “Operating profit before interest as % of Total Operating revenue”. AEA (2007), p. 18.
Although these figures shed a negative light onto European flights offered by network carriers, the interlinked nature of transcontinental long-haul flights and a European feeder network make it impossible to make drastic changes in the European route structure without affecting the profitability of intercontinental operations.

“To many full service EU airlines, the real value of short-haul routes lies in their ability to feed high-yield passengers onto their long-haul networks.”

This relationship is also expressed in the huge differences in load factors that are reported by European network carriers depending on the flight length. While European operations are subject to a load factor of approximately 70%, long-haul operations show a load factor of up to 83% (cf. Figure 27). Besides this difference between different types

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146 Own illustration based on AEA (2007), p. 11
147 Hanlon (2007), p. 147. The dependence on a short-haul feeder network is even expressed more drastically by Cento, who states that “FSCs [Full Service Carrier] are stuck with the HS [Hub&Spoke] configuration to sustain the supply of intercontinental flights.” (Cento (2009), p. 104f). Lufthansa, for instance, reports that only 26% of its passengers on long haul flights are local demand, while the remaining 74% are transfer passengers. At Air France – KLM (37%) or British Airways (59%) the share of local passengers on long haul flights is significantly higher, which can be explained by the fact that they operate out of larger catchment areas such as Paris, Amsterdam or London. As a result, an efficient feeder network is designated as the “lifeline for Lufthansa’s longhaul system” (cf. Garnadt (2008), http://investor-relations.lufthansa.com).
of operations it is also obvious that even if recent improvements are taken into consideration, the average load factor on short-haul routes operated by network carriers is still by around 13 percentage points below the load factors reported by leading European LCC such as Ryanair and Easyjet.

Based on these figures it becomes obvious that due to significant economies of scale, scope and traffic density, carriers that operate a large intercontinental network are in a better situation with regard to offering a short-haul network. Put in other words, without significant local traffic to or from the hub or revenues from routes with low competition intensity that allow for above-average yields, small network carriers that are (based on their limited network size) not able to feed enough transfer passengers to their long-haul network are at a large disadvantage to their larger rivals.

In light of this development and the fact that the overall industry profit margin between 1999 and 2008 was in average only 1.1 percent, many smaller network carriers have in the last years been subject to financial problems (Sabena, Swiss Airlines, Austrian Airlines, Alitalia, etc.) that resulted in them either exiting the market, reducing services or

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148 Own illustration based on AEA (2007), p. 5 & 15; Figures of 2007 only take into consideration the first nine months of the year. AEA = Association of European Airlines.
149 One example for such routes would be operations to Eastern European countries which are (often due to missing traffic rights) not subject to severe competition by LCC. In this regard the routes from Vienna to Bucharest or Belgrade could serve as examples. While the network carrier Austrian Airlines had been able to generate substantial yields on these routes as long as it was only exposed to competition of network carriers from other countries, prices on both routes were subject to strong decreases after LCC (e.g. FlyNiki) have started operating these routes in 2007 and 2010 respectively.
being purchased by a larger carrier.\textsuperscript{150} In many cases the consequence of network airline takeovers by other network carriers was a partial redundancy of overlapping networks that led to a diffusion of some of the advantages of hub & spoke networks. Therefore in the integration process of smaller carriers it has to be evaluated which routes should only be served from one hub in order to profit again from bundling economies.\textsuperscript{151} However, “to consider all these overlaps and related costs as cost savings potential would be too easy. This might also be the source for further revenues as long as the alliance partners exploit the s-curve effect jointly.”\textsuperscript{152} Furthermore it has to be taken into consideration that many of the larger European hub airports (e.g. London Heathrow or Frankfurt) are currently operating at maximum capacity during peaks hours which limits the potential for further traffic consolidations.\textsuperscript{153} Therefore the following chapters are intended to explore how airline alliances and consolidations affect the existing network structures, and whether flexible time-range tickets are a vital mean to turn multi-hub networks into an asset in the intra-continental competition against LCC.

\section*{2.3 Airline cooperation, alliances and airline mergers}

In reaction to the growing importance of LCC, network carriers were increasingly looking for opportunities to cooperate with other carriers in an attempt to increase their market presence and to decrease operating costs. More specifically the following motives can be found as drivers for cooperation:

- **Improved market access and improved value proposition**
  Cooperation allows airlines to offer routes in markets where they would otherwise either for legal reasons (e.g. missing traffic rights), missing production capacity (e.g. no suitable aircraft or slots available) or due to a poor market presence (e.g. unknown brand name, missing sales network) not be able to offer services. Thereby the involved airlines are able to \textit{extend} their \textit{network} and / or to offer their customers higher frequencies on existing routes.

- **Economies of scale**
  By jointly using resources (e.g. handling desks at airports, IT-systems, maintenance facilities, etc.) airlines can spread fixed costs of these cost items over a larger output, thereby reducing the costs per transaction or produced unit.

- **Better bargaining position towards suppliers**
  By joining forces, cooperating parties are able to increase their market power towards suppliers (such as airports or fuel suppliers).

- **Use of subsidiarity principle to increase overall efficiency or quality**
  By assigning tasks to the cooperation party that is best suited to fulfill a task the efficiency and / or the quality of a process can be improved (e.g. according to the

\begin{footnotesize}
\begin{itemize}
  \item \textsuperscript{150} Cf. Tarry (2010), p. 28
  \item \textsuperscript{151} Cf. Dennis (2005), p. 183
  \item \textsuperscript{152} Auerbach / Delfmann (2005), p. 91
  \item \textsuperscript{153} Cf. Verkehrsrundschau (2007), www.verkehrsrundschau.de. During peak hours, London operates at 99.8\% of its capacity (Frankfurt 98.5\%).
\end{itemize}
\end{footnotesize}
‘landlord’ concept airlines usually assign certain tasks such as handling or sales to their cooperation partner in the respective home country of the partner).

- **Reduction of competition intensity**
  By joining forces airlines are (at least on some routes) able to decrease competition or - by jointly offering more frequencies – to improve their product in comparison to remaining competitors. For this reason, planned extensive cooperation attempts are usually scrutinized by antitrust authorities.\(^{154}\)

To achieve these goals, airlines can select from a range of measures that vary according to the level of integration (cf. Figure 28). Among other factors, this intensity can be derived from the length of the cooperation (e.g. one time or long-term partnership), the legal and financial framework (market based transaction, equity holding transactions, foundation of new legal entities) and the number of involved parties (bilateral or multilateral).

![Figure 28: Level of integration of various airline cooperation measures](image)

In the following, starting with the loosest forms of cooperation, the most relevant measures and their impact on the current market environment will be shortly introduced.

### 2.3.1 Operative airline cooperation measures

To overcome short-term capacity shortages airlines may lease aircrafts (sometimes including their crews) from other airlines, an operation that is referred to as dry lease or wet least (in case the crew is leased as well). Although inter-airline leases sometimes

\(^{154}\) Cf. Sterzenbach / Conrady / Fichert (2009), p. 273f
\(^{155}\) Cf. Cento (2009), p. 39
cover several months, the transaction usually does not involve any complex legal constructions but is executed according to market standards.

A special type of a highly standardized cooperation is the provision of **interlining services** that are offered under the IATA-prorate regime. This allows travel agents that are authorized IATA agents to issue flight tickets that involve flight sectors which are operated by several carriers. These airlines do not need to have any close linkage, as long as they are both IATA members. The collected revenues are distributed to the involved carriers according to a detailed prorate scheme by the IATA clearing house.  

The practice of selling seats on the flight of a cooperating carrier under one’s own flight number is referred to as **code sharing**. Depending on the degree of interlinkage, one-way code sharing and (parallel) two-way code sharing can be differentiated. While in the first case, one airline can sell seats on a particular flight from another ‘operating’ carrier where it does not operate (often a complementary feeder flight), in the second case, both airlines operate flights on the same route and offer not only their own seats but also have the possibility to sell seats from flights of the competing carrier (e.g. Austrian Airlines and Air France share codes of all their Vienna – Paris flights). Since parallel code sharing allows both airlines to offset variances in demand more easily by deviating unexpected (excess) demand onto the other carrier’s flight, “airlines that choose […] partners serving the same route can both increase their load factors and reduce operations costs as a result of risk pooling.”

Depending on the agreed risk and revenue sharing various commercial models of code-sharing can be differentiated: In a ‘free sale’ (also referred to as ‘free flow’) agreement, the partner airline has the opportunity to resell a certain amount of seats that it purchases from the operating carrier at a predetermined rate under its own pricing scheme. The demand risk is fully borne by the operating carrier. In a **blocked space** agreement, the partner purchases a fixed number of seats from the operating carrier that it sells independently from the former. While in case of a ‘hard block’ the partner is not entitled to return unused seats, a ‘soft block’ agreement allows the partner to give back unsold seats under certain conditions. By entering a blocked space agreement the selling party hopes to increase overall sales through the marketing of the buying party,

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156 Cf. IATA (2008), p. 1ff. Since passengers prefer online journeys (connections with the same airline) higher than interline connections (involving two distinctive airlines), the latter are usually also displayed after the former in computer reservation systems (cf. Bailey / Liu (1995), p. 474). To respond to these customer preferences and to benefit from the resulting CRS ranking mechanism, many carriers use code sharing as a mean to turn interline connections into ‘virtual’ online connections. Furthermore, since airlines prefer entering a market on their own or through a partner (e.g. code-share flights) “there is less incentive to offer joint interlineable fares. Interline fares are now often more expensive than fares charged for online travel.” (Hanlon (2007), p. 192). As a consequence, the importance of classical interlining has drastically declined during the last years (cf. Hanlon (1999), p. 134 ff.).


158 Cf. Chen / Chen (2003), p. 31. Having examined time-series of parallel intercontinental code-sharing flights, Chen / Chen found an increase in the load factor as a result of parallel code sharing that was not found (to the same extent) in the case of complementary code sharing. A more thorough presentation of the concept of risk pooling is given in chapter 3.3.3.1.
thereby allowing for higher utilization of aircraft (economies of scale), while the buying party can generate revenues on thin routes which it does not want to operate itself.\footnote{Cf. Hanlon (2007), p. 167; Conrady / Sterzenbach / Fichert (2009), p. 280. Examples for routes with blocked space agreements of Austrian Airlines in 2005 were the routes from Vienna to Cairo (Egyptair) or Amman (Royal Jordanien). For the sake of completeness pool agreements can be mentioned as another form of bilateral cooperation, in which airlines jointly decide about schedules, capacity as well as a revenue or profit sharing mechanism. While this type of cooperation is still present in some parts of Asia and the Southern hemisphere it is hardly used in the USA or the EU anymore (cf. Doganis (2002), p. 39), but has to some extent been replaced by airline franchising, i.e. the practice that the franchisor (e.g. Lufthansa) takes over the majority of marketing and sales tasks (as well as the demand risk in many cases) for a franchisee airline (e.g. Augsburg Airways or Contact Air) that operates regional routes for the main carrier (cf. Denton / Dennis (2000), p. 179).}

### 2.3.2 Multilateral airline alliances

In an attempt to deepen the cooperation among airlines, the first intercontinental alliances (that still exist today) were founded in the 1990s. After a few changes in the airline alliance landscape there are currently three global alliances (cf Table 9) that have in 2007 transported about 73% of all global passengers.\footnote{Cf. Star Alliance (2009a), p. 11}

<table>
<thead>
<tr>
<th></th>
<th>Star Alliance</th>
<th>Oneworld</th>
<th>SkyTeam</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Member airlines</strong></td>
<td>26 (incl. Lufthansa, Singapore Airlines, United Airlines, etc.)</td>
<td>12 (incl. British Airways, American Airlines, Iberia, Quantas, etc.)</td>
<td>11 (incl. Air France-KLM, Delta, Aeroflot, China Southern, etc.)</td>
</tr>
<tr>
<td><strong>Passengers (million)</strong></td>
<td>604</td>
<td>328</td>
<td>384</td>
</tr>
<tr>
<td><strong>Fleet size (planes)</strong></td>
<td>3,995</td>
<td>2,280</td>
<td>1,941</td>
</tr>
</tbody>
</table>


The increasing popularity of alliances can be explained by a better exploitation of the benefits that also motivate airlines to form code share agreements. In addition, alliances allow airlines to benefit from a drastic increase in network size that also allows them to offer a global product, which is especially attractive to high-yield business passengers. Besides profiting from coordinated schedules, passengers can usually also collect and redeem miles of their Frequent Flyer Program in the entire flight network of the alliance. These programs are not only very popular among business travelers (with about 90% of business travelers participating in at least one scheme) but have also proven to be extremely effective in influencing the purchase decision. A survey among travel agents revealed that 57% of passengers “always or almost always” select a flight where they can build up mileage points. Because business travelers do not have to pay for their flights on their own in most cases, this can also imply that the cheapest option is
discarded in favor of the option where the traveler can collect more miles for his private account. Since the accruable miles usually increase in a non-linear way FFP provide travelers with a growing incentive to stay within an alliance, thereby making it more difficult for other alliances to enter a certain market. On the cost side, alliances enable airlines to profit from economies of scope due to a joint offer that can be produced at a lower cost than it would be the case if two airlines separately offered the same routes at the same frequencies. Furthermore, by bundling traffic in alliance hubs, airlines profit from economies of scale and density. From a competition viewpoint it can be noted that alliances decrease competition on routes that are served by several alliance members, while they at the same time increase the competition between alliances.

Given the multi-faceted advantages of joining an alliance, not being part of an alliance is in many cases seen as a competitive disadvantage. It is therefore not surprising that almost all European network carriers have joined one of the major alliances during the last years.

2.3.3 Horizontal airline mergers
Although airline alliances, due to high entry- and exit costs usually involve a long-term commitment of their members, there is a residual risk of carriers exiting the alliance that limits the achievable degree of integration. Prominent examples for alliance changes include Austrian Airline’s move from the Qualiflyer Group to the Star Alliance in 2000 or the recent switch from Skyteam to Star Alliance made by Continental Airlines. While alliances aim at achieving a strong standardization on the visible aspects of the product (e.g. customer service, frequent flyer programs, etc.), in many cases more internal areas such as revenue management or network planning are managed individually (cf. Figure 28 that shows the degree of integration of various types of IT-systems in alliances).

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164 Cf. AEA (2009b), files.aea.be; Out of 33 passenger airlines that are members of the Association of European Airlines only some smaller carriers (e.g. AeroSvit, Air Malta, Cyprus Airways, Icelandair, Jat Airways, Luxair, Olympic Airlines, Ukraine International Airlines) as well as one carrier that has more and more evolved into a LCC (Aer Lingus) have so far refrained from joining an alliance.
165 Cf. Handelsblatt (2009), www.handelsblatt.com
This missing integration can to some extent be explained with the high investment costs of an IT-platform transfer (and the required staff training), which – although they would be outweighed by the synergy gains within the entire alliance – are in many cases too large to be justified based on the expected savings of one carrier. Another example where the remaining risk of alliance changes prevents airlines to realize joint savings is the refusal to weed out redundant operations, i.e. to decide that a certain city is only connected through one of several alliance hubs in order to profit from economies of scale and density. Due to the high costs of re-starting a formerly abandoned connection (which would be necessary in case of changes in the alliance structure) there has been reluctance of individual airlines to give up a connection in many cases. These examples illustrate the need for airlines to establish a common bottom line, e.g. by founding a joint venture, acquiring shares of the partner airline or by fully buying the company), in case they want to reap benefits resulting from a strong integration in the area of network planning and yield management. Together with a lift of many regulatory restrictions regarding airline ownership (e.g. ‘substantial ownership’ or ‘effective control’ clauses in bilateral air transport agreements) in the course of the European market

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166 Cf. Pandit (2009), p. 7;
168 Joint ventures that also involve revenue sharing became very common for transatlantic services. The first joint-venture that has been granted antitrust immunity was founded by Northwest Airlines and KLM in 1993. A more recent example is the joint venture "Atlantic Plus-Plus" that has been founded in 2009 and includes Lufthansa, Air Canada, United Airlines and Continental Airlines (cf. Handelsblatt (2009), handelsblatt.com).
169 Section 5 of the International Air Services Transit Agreement that forms an annex to the Chicago convention of 1944 states that "each contracting State reserves the right to withhold or revoke a certificate or permit to an air transport enterprise of another State in any case where it is not satisfied that substantial ownership and effective control are vested in nationals of a contracting State" (ICAO (1944), p. 3). This so-called "effective control" or "substantial ownership" clause has been integrated into many bilateral air service agreements, thereby preventing airlines to merge in case this would result in a loss of traffic rights that are tied to the ‘nationality’ of one of the carriers. However, as the European Union starts to replace individual member states in newly negotiated bilateral air service agreements as contracting partner (e.g. in case of the ‘open skies’ agreement signed with the USA) and airlines are finding ways to keep national ownership up in case of a merger (e.g. by setting up a foundation in the country of the purchased airline) the importance of these clauses has strongly declined, giving way to a range of mergers (compare for example

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liberalization, this situation has resulted in a range of mergers and acquisition during the last years.

“A merger potentially allows 100% consolidation, while in alliances integration is much more limited. In other words, mergers can better achieve the objectives for which alliances were formed.”

Recent examples of significant mergers include the consolidation of Air France and KLM into a new holding company Air France-KLM in 2004, the merger of Northwest and Delta in 2009 (which led to the extinction of the Northwest brand) and the purchase of Swiss Airlines and Austrian Airlines by Lufthansa in 2005 and 2009 respectively.

In a survey among airline executives it was found that 88% expect further market consolidation steps in the future. Expected consolidation steps include the total takeover of Brussels Airlines by Lufthansa (currently Lufthansa holds 45%), the – already initiated - merger between British Airways and Iberia, a takeover of the Czech Airline CSA by Air France-KLM and the purchase of Scandinavian Air Systems and the Polish LOT by Lufthansa. As a result of the ongoing and expected market consolidation several airline groups see themselves confronted with the operation of (partly) overlapping networks, which results in a significant optimization potential in the areas of network planning and yield management, which will be discussed in the following chapters.

2.4 Network design and scheduling in multi-hub networks

2.4.1 The basics of network design and scheduling

Given the long-term implications of a selected network design (for instance due to the resulting fleet requirements) this planning step lies at the core of an airline’s strategy. It aims at maximizing the profitability of the entire network and comprises three phases:

- In the network development phase (that usually covers a planning horizon of up to five years) an airline evaluates the market potential of various Origin-Destination pairs (passenger numbers, expected yields, customer preferences, competitive situation, etc.), decides which markets it wants to cover and initiates the required fleet adaption steps (e.g. order of long-haul aircrafts).
- In the actual flight schedule planning phase an airline decides about offered itineraries, departure and arrival times, frequencies, the assigned capacity (i.e. the preliminary assignment of an aircraft type) and its pricing approach in


Iatrou / Oretti (2007), p. 21


Cf. Sobie (2010a), www.flightglobal.com

This also includes the question whether the market potential of a particular O&D and the cost structure of the airline justify the establishment of a non-stop link or whether an indirect connection should be offered. In the latter case, the geographic position of the hub has to be taken into consideration in order to be able to assess the attractiveness of the planned flight offer in comparison to competing airlines.
selected markets. Restrictions that have to be observed are capacity constraints (of aircrafts, crew or the airport in question) as well as the need for suitable slots.

- During the last months prior to departure of a specific flight an airline specifies the operational details of the flight (e.g. aircraft and crew assignment) and optimizes the achievable revenue by means of revenue management and short-term schedule and capacity adjustments.\textsuperscript{174}

For a network carrier the creation of a flight schedule is further complicated by the need to coordinate the departure and arrival times of various flights (often having differing flight distances) in order to allow passengers to connect at the hub. As shown in Figure 30, this process requires airlines to build clusters of flights with similar durations (e.g. short-haul flights that last up to two hours per direction, shown in grey in the illustration) which are then synchronized at the hub in so called arrival and departure banks (waves). Within a wave, an airline has to manage the trade-off between connectivity (i.e. foresee at least the minimum connecting time of the hub airport between the last arriving and the first departing flight in order to maximize the number of possible connections) and productivity (i.e. the attempt to minimize turnaround times of aircrafts in order to increase aircraft and crew utilization rates). In practice, airlines will discard many possible connections since they either do not make sense from a geographical point of view (for instance due to backtracking) or because there is not sufficient customer demand for them (e.g. due to a more attractive direct service by a competitor). To decide whether a city-pair itinerary could possibly be offered as a connection, the detour factor in comparison to a non-stop flight is taken into consideration.\textsuperscript{175} In practice a detour factor of up to 1.35 is considered during the flight scheduling process.\textsuperscript{176}

![Figure 30: Hub structure and wave planning process of network carriers\textsuperscript{177}](image)

This part of the flight scheduling process is usually done in an iterative way, which means that an initially drafted flight schedule that is executable from an operational point of view may be revised several times based on the expected profitability. To estimate

\textsuperscript{174} Cf. Conrady / Sterzenbach / Fichert (2009), p. 308ff
\textsuperscript{175} Cf. Grosche (2007), p. 112
\textsuperscript{176} Cf. Jasvoin (2006), p. 36
\textsuperscript{177} Own illustration based on Maurer (2006), p. 202; Conrady / Sterzenbach / Fichert (2009), p. 336
2.4.2 Challenges for network planning in multi-hub airline networks

As a consequence of alliances and mergers, airline groups are confronted with partly overlapping networks. In case a fully integrated airline operates several hubs in geographic proximity this results in a duplication of its network. “Network duplication may appear when an airline ends up competing with itself across duplicated hubs.”\(^{179}\) As a consequence many authors consider closing or downsizing of hubs as the resulting necessity of this development.\(^{180}\)

The resulting hubbing strategy that allows airlines to reap the benefits of a central traffic consolidation by bundling flights at a single hub is designated by Jäggi as a ‘stand-alone’ strategy.\(^{181}\) However, due to capacity constraints at major hub airports, the extent to which airline groups that want to maintain their current traffic volume can reduce the extent of network duplication by shifting traffic to one hub is limited.\(^{182}\) To overcome these limitations, many airlines have opted for a ‘reliever strategy’, in which two hubs in close proximity are selected in order to be able to grow despite capacity limitations at the main hub (e.g. Lufthansa with Frankfurt and Munich Airport or British Airways with London Heathrow and London Gatwick).

In addition to these strategies that focus on no more than two hubs, Jäggi also presents a third option. The ‘ubiquity strategy’ emphasizes the value of a multi-hub network, if the demand flow structure of the network in combination with the local competitive situation restricts airlines to close down individual routes or hubs in case they want to maintain their overall market share. As Jäggi concludes, multi-hubs can be advantageous if they allow airlines to shorten the travel time between two spoke airports due to a more direct routing via a regional hub in comparison to the routing through a central hub (that often involves a considerable detour). To assess, which strategy is meaningful in a particular environment, the demand patterns in a network should be analyzed.\(^{183}\)

Having examined various network economies, Coyne and Dye have identified three common usage patterns that can also be identified in airline networks (cf. Figure 31).

\(^{179}\) Burghouwt 2007, p. 28  
\(^{180}\) Cf. Dennis (2005), p. 183; Burghouwt 2007, p. 28  
\(^{182}\) Cf. Auerbach / Delfmann (2005), p. 91 & Verkehrsrundschau (2007), www.verkehrsrundschau.de. During peak hours, London Heathrow airport operates at 99.8% of its capacity (Frankfurt 98.5%).  
If all arcs of a possible network are equally valued by the customer base (‘zero concentration’), airlines should lay their focus on building a network with high overall connectivity, which can be achieved by building large waves at a central hub. If regional traffic clusters can be identified (‘zone concentration’), airlines are advised to bundle passengers in a regional hubs in order to be able to offer a competitive product in these distinct areas. A concentration of traffic on individual connections (‘lane concentration’) implies the establishment of dense services on the selected spokes (e.g. by means of a separate point-to-point operation that aims at achieving a high productivity on these trunk lines) besides a central hub that allows passengers to reach low-volume destinations.\(^{185}\)

An analysis of Intra-EU traffic flows shows that due to the regional differences in the EU (e.g. with regard to population density and the level of economic development) there are large differences in the demand for various O&Ds (cf. the different tie strengths in Figure 32).

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\(^{184}\) Based on Coyne / Dye (1998), p. 105. The traffic volume on various arcs is illustrated by means of the respective line strength.

With regard to the usage patterns described above, one can observe a strong dominance of specific city pairs ('lane concentration') as well as certain regional clusters ('zone concentration', e.g. domestic routes in Spain or the UK, Scandinavian routes etc.). While the former give ground to LCC that specialize on point-to-point routes, the latter suggests that in certain geographic areas, a central 'stand-alone' hubbing strategy would fail to provide competitive services. Therefore, in addition to the capacity shortages at major European hubs, the rationale for a multi-hub system is also supported from a geographic point of view, if the involved airlines manage to coordinate

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186 Own illustration, based on route-specific data of Eurostat (2010), epp.eurostat.ec.europa.eu. Only intra-EU O&Fs (including Switzerland & Norway) with more than 200,000 passengers per year were included in the illustration. The tie strength symbolizes the demand for a specific relation. Airport coordinates were calculated based on Partow (2003), www.partow.net; Network illustration made with Pajek 1.26.
their network in a way that various O&Ds are always routed via the nearest hubs. By minimizing the involved detours, airlines can thereby not only improve the overall travel time (which results in a more attractive product to time-sensitive travelers) but can also reduce the average sector length. Since smaller stage lengths allow for a shorter Hub Repeat Cycle (i.e. the elapsed time between the start of two consecutive waves) this allows airlines to increase the number of waves that can be realized at their hubs.\footnote{Cf. Jäggi (2000), p. 113 & 259}

### 2.4.3 Optimized scheduling in multi-hub airline networks

In the case there is sufficient demand to justify a connection of a spoke city to several hubs of an airline group or an alliance, the partners can improve their product offering by streamlining their schedules in order to increase the overall number of available frequencies or to improve the temporal distribution of available flights to a destination.\footnote{Cf. Iatrou / Oretti (2007), p. 4}

Often, the presence of additional hubs with population catchment areas that differ from those of the primary hub is even a prerequisite for adding additional frequencies. While there might for instance not be enough local traffic from a small spoke airport to one hub in order to justify two daily connections (which would require a certain number of high-yield passengers that have the hub as the start or the end point of their journey), it might be economically reasonable to also offer a connection to a second hub (with a different catchment area and therefore also additional high-yield passengers that are willing to pay more for the resulting direct flight than transfer passengers that only use the flight leg as a part of their connection journey).\footnote{This pooling of demand risk across several hubs has for instance been named by Air-France KLM as a key factor that buffered the impact of the financial crisis in 2008. “A cornerstone of the profitable growth strategy in recent years, the dual hub system between Paris and Amsterdam is currently acting as a shock absorber thanks to the diversity of the transfer flows which are not all exposed to the crisis in the same way. It also provides an immediate solution for passengers whose direct flights have been suspended.” (Air France KLM (2009), p. 16).}

By offering more scheduled departures than a stand-alone airline, an airline group is also able to gain higher customer awareness for certain destinations, which finally also results in a higher market share of the involved airlines.\footnote{Cf. Grosche (2007), p. 21}
An example for such a scheduling optimization in a multi-hub network can be seen in Figure 33. While the first displayed connection (Stockholm to Sarajevo) is already streamlined with regard to offering passengers in Stockholm several reasonable departure times, the second connection (‘Western Europe’ to Rostov) still shows potential for improvement. Within this example both partner airlines offer flights from their hubs to Rostov around noon, thereby competing for almost the same transfer passengers. Within a jointly planned network it would make sense to split these flights into a morning as well as (late) afternoon connection in order to offer customers more choice as well as better travel times.\textsuperscript{192} Thereby the alliance would be able to address more passengers in comparison to competing alliances.

Besides an optimization of specific O&Ds, airlines can also aim at interweaving the waves of hubs that are within close proximity of each other (e.g. Frankfurt [FRA] and Munich [MUC] within the Lufthansa network) This can turn into a competitive advantage, since the airline can offer customers (who do not live in the catchment area of one of their hubs but have to use a feeder flight to the hub) several different departure times from origin cities which are connected to both hubs. Figure 34 shows how the departure waves at FRA and MUC to different regions are intentionally distributed in a complementary way along the day. It can be seen that e.g. North America flights arrive in MUC one hour earlier before similar flights arrive in FRA. Thereby potential onward flights to European cities leave MUC already at half past seven, while in FRA the first flights to European destinations leave at around nine o’clock. This means that a traveler who wants to fly from the US east coast (e.g. Washington) to a city in Eastern Europe with Lufthansa has the choice between leaving at either approximately 5pm (and transfer at MUC) or at around 7pm (and transfer via FRA).

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figures/figure33.png}
\caption{Schedule optimization in a multi-hub network\textsuperscript{191}}
\end{figure}

\textsuperscript{191} Cf. Deutsche Lufthansa (2009), S. 10
\textsuperscript{192} Cf. Maurer (2006), p. 402
Besides improvements with regard to the product attractiveness, operating a multi-hub network also allows airlines to better accommodate routes of certain flight duration that do not fit into the foreseen hub repeat cycle (e.g. because they are shorter than the average sector length) and would therefore result in unproductive idle time of the aircraft and the crew either at the hub or the spoke airport. For instance, Austrian Airlines stated that their airplanes had to wait two hours at the spoke airport Düsseldorf prior to flying back to their hub in Vienna, in order to achieve a good fit with the wave structure. Figure 35 shows how Delta Airlines manages to integrate flights of various lengths into its hub waves at Atlanta and Dallas. By combining three short legs (Atlanta – Huntsville – Monroe – Dallas) the airline manages to keep all three involved aircrafts flying, while at the same time all flights arrive almost simultaneously at the second hub airport.

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195 By using aircrafts on different hubs, airlines are able to increase the productivity of their fleets. However, this can also lead to a propagation of disturbances at one hub onto another. For this reason, Lufthansa, for instance has decided to clearly separate the aircraft operations at its hubs in Frankfurt and Munich (cf. Travel Inside (2006), www.travelmanager.ch).
In conclusion one can say that although the presence of alternative hubs in the same region at first leads to a dilution of the bundling advantages of a single hub, in case of capacity limitations at the main hub and if airlines manage to achieve a higher aircraft utilization as well as more direct and more frequent, well-coordinated departures on through-hub markets, the operation of a multi-hub network can result in a competitive advantage. As Wojahn puts it “the multi-hub system [...] on the one hand [...] allows enough traffic consolidation to permit operation at efficient aircraft sizes and flight frequencies, on the other hand it does not concentrate too much traffic on single airports, and thus the capacity constraints do not displace the airline too far from unrestricted equilibrium frequencies.”

2.5 Yield Management

Yield management (YM) aims at increasing the overall contribution paid by passengers on a flight, by taking advantage of the different willingness-to-pay behaviours of different customer segments. Furthermore, by adjusting prices to expected demand, yield management also serves as a vital mean to even out demand peaks (e.g. by offering a flight cheaper on Saturday morning, an airline may convince some passengers who originally wanted to take the well-booked Friday evening flight to postpone their travel). Thereby the airline can transport more passengers and in most cases also increase the contribution. The following chapter aims at analysing, how YM can be used to increase the overall revenue and to even out discrepancies between offered capacity and passenger demand on a spatial and temporal level. By applying these principles to the pricing of several available itineraries in a multi-hub network, the main foundations of flexible time-range tickets are presented.

2.5.1 Prerequisites and theoretic foundation of Yield Management

The term Yield Management (YM) has been introduced in the 1980s and describes methods which aim at supporting a firm to "sell the right inventory unit to the right type of

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196 Illustration by the author based on Dennis (2000), p. 82
197 Wojahn (2002), p. 159
customer, at the right time, and for the right price.”\textsuperscript{198} Having the airline industry in mind, \textit{Gallego} and \textit{van Ryzin} define YM more specifically as “the practice of using booking policies together with information system data to increase revenues by intelligently matching capacity with demand”.\textsuperscript{199}

The introduction of YM has led to considerable changes in the airline industry. American Airlines, which has been one of the first airlines to apply single-leg YM, has been able to generate additional revenues of approximately $500 million in the first year after the introduction of a more differentiated fare structure.\textsuperscript{200} In general it is estimated that YM is able to raise the revenues of an airline by 4-5% per year.\textsuperscript{201} Table 10 shows the preconditions which have to be fulfilled in order for Yield Management to be an appropriate tool and their characteristics in the airline industry.

<table>
<thead>
<tr>
<th>Prerequisites for using YM and corresponding airline industry characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Relatively fixed capacity</td>
</tr>
<tr>
<td>2. Ability to segment markets</td>
</tr>
<tr>
<td>3. Perishable inventory</td>
</tr>
<tr>
<td>4. Products are sold in advance</td>
</tr>
<tr>
<td>5. Fluctuating demand</td>
</tr>
<tr>
<td>6. Low marginal sales costs but high marginal capacity change costs</td>
</tr>
</tbody>
</table>

\textbf{Table 10: Prerequisites for using YM and corresponding airline industry characteristics}\textsuperscript{202}

Yield Management builds upon the concept of price discrimination, originally introduced in 1920 by Arthur Pigou, who distinguished between three degrees of discrimination. First degree discrimination is given, if a firm charges every customer an individually negotiated price which reflects the customer’s willingness to pay. In the case of second degree discrimination a firm makes several tariffs available to its customers, which entail

\textsuperscript{198} Kimes (1989), p. 348  
\textsuperscript{199} Gallego / van Ryzin (1997), p. 24  
\textsuperscript{200} Cf. Smith et al. (1992), p. 31  
\textsuperscript{201} Talluri / van Ryzin (2005), p. 10; the authors initially declare that they treat Yield Management (“the traditional airline term”) and Revenue Management as synonyms (cf. p. 2). Since this work addresses a problem of the airline industry the term Yield Management will be used exclusively in the following.  
conditions that lead to a self-selection of more expensive tariffs by customers with a higher willingness to pay. As shown further below, this form of price discrimination\textsuperscript{203} is the dominant type in the airline industry. Third degree price discrimination uses person-specific screening criteria as a discriminator between different tariffs (e.g. availability of a discount for students or children under the age of 18).\textsuperscript{204}

If segments can be clearly distinguished and separated by so-called fencing mechanisms, price discrimination can lead to an increase in overall revenues by absorbing two distinctive sources of revenue which would otherwise be spoiled (cf. Figure 36):

- Extraction of untapped consumer surplus: If airlines would only charge a single price, the consumer surplus of customers with a higher willingness to pay would be lost.
- Accommodation of otherwise unsatisfied demand: In case of ample capacity, airlines can trigger additional demand by offering tickets at a price below the standard price.

![Figure 36: Revenues with and without price discrimination\textsuperscript{205}](image)

Traditionally, the main customer segmentation criterion in the airline industry is the purpose of the trip (business or leisure). The underlying assumption is that business

\textsuperscript{203} It is often discussed, whether a flight on a certain date booked two months in advance is actually a different product than the same flight booked on the day of departure, which would imply that a temporal price change can be classified as product differentiation (cf. Sterzenbach / Conrady / Fichert (2009), p. 354). Taking a narrow perspective, though, product differentiation can only be assumed if the provision of two distinct goods or services results in different production or service costs. While this is often the case with physical goods (e.g. as a consequence of the required transportation to the store, even the same goods are subject to different costs in case they are sold at different locations), with regard to airline seats on the same flight (in the same cabin class) there are – apart from differing paying moments and the corresponding loss of accrued interest - hardly any justifiable cost differentials between an early and a late booking. As Philips (1983, p. 6) more specifically notes, “price discrimination should be defined as implying that two varieties of a commodity are sold (by the same seller) to two buyers at different net prices, the net price being the price (paid by the buyer) corrected for the cost associated with the product differentiation.”

\textsuperscript{204} Cf. Pigou (1920), p. 279ff

\textsuperscript{205} Based on Maurer (2006), p. 343
passengers book at short notice and require a high degree of flexibility and comfort. In return they show a relatively high willingness to pay (especially if they do not pay the trip themselves). On the other hand leisure travelers are willing to make sacrifices regarding time of travel or comfort in order to get a cheap ticket. Although this main criterion is still valid, recent research argues that this categorization is not detailed enough and that there are more segments that can and should be distinguished (cf. also chapter 4.3.1). In order to efficiently skim the available consumer surplus of customers with a higher willingness to pay, airlines use so called rate-fences. These barriers result in a self-assignment of customers to fare classes that match their booking habits and requirements. Rate fences can, for instance by means of an unacceptable advance booking period, prevent business customers from selecting a discounted Economy Class fare. Overall airlines usually offer up to 26 main booking classes as well as a large number of subclasses that often follow a standardized IATA scheme (cf. Table 11).

<table>
<thead>
<tr>
<th>Fare Code designators</th>
<th>Cabin class</th>
<th>Temporal availability</th>
<th>Fare, ticket and passenger type</th>
<th>Taxes included?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Format</td>
<td>1 letter (mandatory)</td>
<td>1 letter (conditional)</td>
<td>2 letters (conditional)</td>
<td>1 letter (conditional)</td>
</tr>
<tr>
<td>Available Categories</td>
<td>• First Class (A, F, P, R), • Business Class (C, D, I, J, Z), • Economy Class (B, E, H, K, L, M, N, Q, S, T, V, W, X, Y)</td>
<td>• Seasonal (e.g. H=High, K=shoulder, L=Low) • Part of week (e.g. W=Weekend) • Part of day (e.g. N=Night)</td>
<td>E.g. ticket types: • AN = Non Refundable Advance Purchase • FL = restricted to certain flight numbers • UU = Standby Fare E.g. passenger types: • IN = Infant • ZZ = Youth Fare</td>
<td>Y = taxes included N = not included</td>
</tr>
<tr>
<td>Example: WKFLY</td>
<td>W (Economy)</td>
<td>K (shoulder season)</td>
<td>FL (restricted to certain flights)</td>
<td>Y (incl.taxes)</td>
</tr>
</tbody>
</table>

Table 11: Recommended IATA booking class designation scheme

Rate fences that distinguish various booking classes consist either of physical (e.g. business class seats) or non-physical (e.g. rebooking options) separation mechanisms. As shown in Figure 37, the majority of currently used rate fences can be classified as non-physical differences. In this context, the uncertainty regarding the actual routing in case of flexible time-range tickets would constitute an additional non-physical rate fence.

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208 Cf. IATA (2003), p. 451ff
As shown above many (non-physical) rate fences actually deliberately lead to a deterioration of the product 'air travel', by limiting its availability or the involved flexibility in order to make it unattractive to passengers with a high willingness-to-pay. This practice, which is by some authors also referred to as 'damaged goods phenomenon', ensures that the persons who value a seat on a particular flight the most actually can obtain it by paying more than others, thereby leading to an efficient distribution of seats. Furthermore, by better skimming the consumer surplus of high-yield passengers, airlines can also offer seats to customers with a lower willingness-to-pay which in the long run benefits all traveler segments, since it allows airlines to reduce the costs per seat (by using larger aircrafts) or to increase the offered service frequency.\textsuperscript{210}

\textsuperscript{209} Adapted from Friesen (2008), p. 98
\textsuperscript{210} Cf. Eldad (2005), p. 222f; Botimer (1996), p. 316
2.5.2 The Yield Management Process

Integrated Yield Management consists of the simultaneous management of fares, the distribution of the seat inventory to various fare classes as well as the determination of overbooking rates for the entire flight program of an airline (cf. Figure 38).

![Figure 38: Integrated Yield Management Approach](image)

In a first step, based on historical data of bookings, cancellations and no-show rates, airlines build up a demand as well as a cancellation and no-show-rate forecast. Together with the available capacities and fare classes this data is used in optimization models which generate preliminary booking class limits. These values are then in certain cases manually adjusted by the YM department to reflect previously unconsidered input data (e.g. special events, group bookings, etc.). According to a survey among 37 airlines that use YM systems, in average 36.9% of their flights are automatically priced without any manual intervention by a yield manager.

At Lufthansa, to give an example, the short-term pricing of 1,500 daily flights is controlled by the YM-department, which during the entire booking period involves up to 200 changes of the capacity limits of approximately 20 booking classes per flight.

2.5.2.1 Pricing and seat inventory management

Since bookings of high-yield travelers usually arrive later than low-yield demand, the main tasks of Yield Management in the light of a differentiated fare structure is to decide, whether to accept or to reject a booking request of a passenger with a low willingness-to-pay at a certain point of time by either extending or limiting the availability of discounted tickets (cf. Figure 39).

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211 Based on Maurer (2006), p. 346
212 Prior to the calculation of the no-show rate forecast the input data is cleaned by removing so called ‘bad data’ points (i.e. no-show rate data collection points which were for instance influenced by an unusually high number of delayed transfer passengers or a large traffic jam on the motorway to the airport).
213 Cf. Weatherford (2009), p. 35
214 Cf. Sterzenbach / Conrady / Fichert (2009), p. 380
In case a booking request is denied (by not offering a ticket in the expected price range) this can either lead to a loss of revenues (if the customer books a flight at a competing airline), a deviation of demand (if the customer books another flight of the same airline) or to higher revenues (if the customer decides to purchase a more expensive seat of the originally requested flight). The costs associated with denying passenger demand are referred to as ‘spill’, while the cases where the passenger books a different seat at the same airline are called ‘spill & recapture’ or ‘upselling’ (in case the passenger decides to purchase a more expensive ticket than originally planned).  

To avoid selling too many discounted seats, airlines use so called fare nesting approaches. This implies that an airline reserves capacity for high-fare passengers by limiting the maximum amount of low-fare tickets that can be sold. Within such nested inventories, any seat foreseen for a low fare class can always be sold to a high-fare class, though. The size of reserved capacity is calculated by weighing the additional revenues of selling an expensive ticket with the probability that a passenger that is willing to pay this amount actually arrives (expected marginal seat revenue - EMSR). Table 12 shows an example for an EMSR calculation, where the price of a Y-class ticket (unrestricted economy class) is assumed with €500 and a low-fare ticket is sold for €200. Within this example the airline should reserve 34 seats for Y-Class bookings.

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215 Vasigh / Tacker / Fleming (2008), p. 299
216 Cf. Sterzenbach / Conrady / Fichert (2009), p. 368
217 Cf. Littlewood (1972), p. 115f. Using real data from British Airways, Littlewood showed that systems that restrict the sale of low-yield fares in order to reserve capacity for forecasted bookings of high-yield customers are superior to unrestricted systems.
218 Cf. Belobaba (1987), p. 120. In an extension of the EMSR (Expected Marginal Seat Revenue) model the author also considered different no-show probabilities in various fare classes by “inflating” the determined number of physical seats in a certain fare class with a no-show factor (cf. p. 139).
Table 12: Expected marginal seat revenue calculation

| Number of Y-Class bookings (n-th passenger) | ... | 30 | 31 | 32 | 33 | 34 | 35 | 36 | ...
| Chance of at least this many Y-Class passengers | ... | 50% | 49% | 47% | 44% | 40% | 35% | 30% | ...
| Expected marginal revenue | ... | € 250 | € 245 | € 235 | € 220 | € 200 | € 175 | € 150 | ...

While this approach produces valid results in a single-leg situation, it might lead to inefficient allocation of seats in a network environment. This is due to the fact that a customer request for a connection journey might be disregarded since its EMSR on one of the legs is smaller than the expected revenue of a point-to-point traveler on the same leg, although the total revenue contribution of the connection passenger might be higher (under the assumption that there is ample capacity on all involved flight legs). This shortcoming led to the development of so-called origin and destination revenue management systems (ODRMS) in the early 1990s. In these systems the customer value with regard to the entire network is considered. Although the move towards an ODRMS poses several challenges to the IT-landscape (drastic increase of data requirements), most network airlines nowadays use this type of YM since it is able to increase revenues by up to 3% in comparison to a single-leg system. To account for the overall network contribution of a passenger a threshold price (so called bid price) is used, which corresponds to the estimated marginal costs to the network which are caused by the consumption of the next incremental seat on a certain flight. If the revenue of a multi-leg journey exceeds the sum of the bid prices along the requested itinerary, a respective booking request is accepted. Bid prices represent the opportunity costs of having to deny another request with a higher network yield. They are therefore again based on forecasted origin-destination (O-D) demand and also consider different fare classes. Since capacity gets scarcer the closer the departure date, bid prices usually rise as time elapses, leading to a consecutive closure of low-fare booking classes.

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220 More specifically, in a two leg itinerary (e.g. A-B, B-C) three cases can be distinguished that require different treatment. In case there is sufficient capacity on both legs, a simpler, leg-specific, yield management would be sufficient to reach an optimal result. For this reason, many airlines restrict the use of ODRMS to flights with an expected load factor of more than 80% (cf. Sterzenbach / Conrady / Fichert (2009), p. 376f). If one of the involved flight legs is subject to large demand, ODRMS outperforms leg-based YM-approaches by giving priority to a connecting passenger (with a higher overall yield) over a local passenger that only flies on the congested segment, even though the leg-based contribution of the latter might be higher. If both flights legs are highly demanded an ODRMS would favor local passengers (with a higher per-leg contribution) over connecting passengers in order to maximize the total yield.
222 Cf. Talluri / van Ryzin (2005), p. 82. The effective ODRMS improvement number is dependent on the network and the demand structure as well as the prevailing load factor (the higher, the better the improvement).
2.5.2.2 Overbooking management

Overbooking is used by airlines to increase revenues, by selling more tickets than there are available seats to account for the fact that in average 5-20% of booked passengers do not show up at the departure day (e.g. passengers with refundable tickets). Since in addition some reservations for a flight are already cancelled prior to departure, airlines usually accept bookings up to the point of 140% of the available capacity. As the departure date approaches (and the number of expected cancellations decrease) this overbooking limit is then lowered to match the expected no-show rate, though. By limiting or extending the available amount of discount tickets, a revenue manager can ensure that the actual bookings stay within the targeted booking corridor which aims at a maximization of the overall flight contribution margin. During the time that a flight is open for bookings an airline furthermore on the one hand has to ensure that enough capacity is reserved for late-booking passengers (which are contributing higher yields) by limiting the amount of available discount-tickets, while on the other hand it should avoid spoilage, i.e. not using the full capacity of the airplane, in order to maximize revenues (cf. the targeted booking corridor in Figure 40).

![Diagram](capacity_management.png)

**Figure 40: Capacity Management by means of Yield Management**

The degree of overbooking varies from flight to flight and depends among other factors on the overall booking situation, the amount of booked passengers with changeable or refundable tickets, as well as the expected No-Show rate. No-Show can be distinguished in accidental ones (e.g. last-minute illness, traffic delays on the way to the airport, late-inbound connecting flight) or deliberate ones (e.g. travelers that book

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224 For instance in 2006, the German carrier Lufthansa has counted 4.6 million No-Show passengers, which is equal to 9% of all transported passengers (cf. Süddeutsche Zeitung (2009), www.sueddeutsche.de).

several tickets for the same day or travelers with flexible ticket that shortly before departure rebook).\textsuperscript{226}

To forecast the No-Show rate, airlines primarily use flight specific data (e.g. historic booking and No-Show data of previous flights), while newer approaches also incorporate passenger specific information to improve the forecast quality. Table 13 shows Passenger Name Record (PNR) based forecast parameters and their expected influence on the no-show rate.

\textsuperscript{226} Cf. Shaw (2007), p. 170
<table>
<thead>
<tr>
<th>Causal factor</th>
<th>Possible characteristics</th>
<th>Influence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passenger direction</td>
<td>outbound / return</td>
<td>If a passenger has already been a no-show on the outbound flight, he or she is most probably also not going to be present on the return flight.</td>
</tr>
<tr>
<td>Fare rules</td>
<td>Changeable / refundable</td>
<td>If a ticket can still be changed or refunded after a no-show, the probability of a no-show increases.</td>
</tr>
<tr>
<td>Type of travel</td>
<td>Domestic / international / intercontinental Non-Stop / connection flight (n-th leg)</td>
<td>For instance, due to late arrivals of incoming feeder flights, the probability for no-show behavior on the second leg of a connection flight is higher than on the first leg (‘misconnex’).</td>
</tr>
<tr>
<td>Number of passengers in the booking</td>
<td>Single person / group booking</td>
<td>Members of a group booking usually show a lower probability of becoming a no-show.</td>
</tr>
<tr>
<td>Point of Sale</td>
<td>Sales channel, country</td>
<td>The behavior of people who book via the internet is different from those who book via a travel agent. Furthermore there are cultural differences between countries.</td>
</tr>
<tr>
<td>Specific Service Requests</td>
<td>Food requests, special assistance requests, seat reservations</td>
<td>Passengers who have invested some time in configuring their booking are more likely to appear at the gate than others.</td>
</tr>
<tr>
<td>Time between booking and flight</td>
<td>Short / long</td>
<td>Early bookers who purchased very cheap discount tickets (that cannot be amended) are likely to behave as no-shows in case their arrangements change.</td>
</tr>
<tr>
<td>Frequent Flyer Status</td>
<td>No status / Frequent Flyer</td>
<td>Frequent Flyers are less likely to act as no-shows than people who only fly very seldom.</td>
</tr>
</tbody>
</table>

Table 13: Passenger Name Record (PNR) based no-show rate forecast parameters

In an empirical study of PNR-based forecasting Lawrence et al. showed that the frequent flier status, the destination, as well as the type of travel (e.g. connection flight) had the highest influence on the actual no-show behavior.

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227 Cf. Smith/Tsai (2005), p. 5; Lawrence et al. (2003), p. 5; Looking on the first flight segment of return booking in the USA, Garrow & Koppelman found that 6% of all bookings resulted in no-shows. This number rose to 10% when the second leg (i.e. the return flight) was analyzed. The increased no-show-probability on return flight is also caused by the practice of “back-to-back ticketing”, i.e. the purchase of two complementary return flights with the intention of only using the first segment of each ticket, instead of buying a single return ticket. This is reasonable from the customer’s perspective, if the cost of two discount tickets is lower than the price of the return ticket that would correspond to the real demand (e.g. if a customer would like to return on the same day). To incorporate this behavior in their forecast processes, many airlines have introduced automated data cleaning mechanisms that detect “back-to-back” bookings and eliminate the respective return flight reservations. Another issue that leads to higher no-show rate on the return flight is the practice of airlines to rebook passengers with changeable tickets onto an earlier flight in case they arrive too early at the airport (cf. Garrow / Koppelman (2004a), p. 402).

228 Cf. Smith / Tsai (2007), p. 5f; Garrow / Koppelman (2004b), p. 239

229 Lawrence et al. (2003), p. 5. Since the authors looked on reservations (and not only on issued tickets) they furthermore also listed the factor “ticket issued” as the criterion with the highest information gain.
2.5.2.3 Legal regulations and the optimal overbooking rate

By overbooking flights, airlines expose themselves to the risk that there are more passengers willing to board the plane than there are seats available, which forces them to deny boarding to some of the passengers that hold a valid reservation. If no volunteers are found airlines have to offer denied passengers a ticket for a different flight to the final destination or the originating point, or reimburse the ticket price and pay a compensation between €250 - €600 (in case the final arrival is delayed). An overview of the legal obligations in case of ‘denied boarding’ is given in Table 14.

<table>
<thead>
<tr>
<th>Region</th>
<th>European Union</th>
<th>USA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Applicability</strong></td>
<td>- Passengers on intra-EU flights or flights to or from the EU who are denied boarding that hold a publicly available ticket</td>
<td>- Commercial flights within the US or originating in the US with a passenger capacity of more than 30 seats</td>
</tr>
<tr>
<td><strong>Required compensation</strong></td>
<td>Either</td>
<td>- The airline has to pay a compensation amounting to 100% of the paid fare of the remaining segments (but not more than $400) if passengers are rescheduled and reach their final destination within two hours (four hours for international flights) of the original arrival time. - This amount doubles (with a maximum cap at $800) if passengers arrive at their destination later than two hours of the original arrival time (four hours for international flights).</td>
</tr>
<tr>
<td></td>
<td>- An alternative ticket to the final destination, - A return flight to the first point of departure, - Reimbursement of the ticket price (in case the trip became obsolete), and a compensation of</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- €250 for all flights up to a distance of 1.500km - €400 for all intra-EU flights covering more than 1.500 km, and for all non-EU flights between 1.500 and 3.500 km; - €600 for all other flights. Depending on the length of the delay the airline has to offer the passenger refreshments, meals, hotel accommodation &amp; two free phone calls.</td>
<td></td>
</tr>
<tr>
<td><strong>Exceptions</strong></td>
<td>- If the airline offers the passenger an alternative transportation that allows him / her to arrive at the final destination within two hours after the original arrival time (three hours for intra-EU flights of more than 1500km and extra-EU flights between 1500 and 3500km / four hours for all other flights) the carrier can reduce the required by compensation by 50%.</td>
<td>- No compensation is required if the airline offers an alternative transportation where the passenger is planned to arrive at his / her final destination within not more than 1h of the originally scheduled time - If the passenger agrees, the airline may also offer a voucher for air transportation at least amounting to the required compensation payment</td>
</tr>
</tbody>
</table>

Table 14: Comparison of EU and US denied boarding regulations

However, given the availability of ticket data with regard to the forecasting process as well as the declining relevance of reservations which are not immediately ticketed this factor is not further discussed in this work.

In 2007, US-airlines have denied boarding to 686,000 passengers, which corresponds to 0.12% of all flown passenger segments (one-way flights). Given the considerable extent of hubbing which prevails in the USA, one has to bear in mind that this corresponds to a higher percentage of affected passengers, though. Of these passengers, 91% have voluntarily accepted to be left behind (in exchange for an offered compensation). Only in the remaining 9% of cases passengers were denied boarding against their will. According to a report of the European Parliament, in 2005 around 1.1 million passengers were denied boarding on flights within or out of the EU, which corresponds to a rate of 0.16%.

If no volunteers are found, usually passengers that have checked in the latest are 'bumped' (because their luggage is often not yet loaded), a procedure which would concern especially valuable business travelers who often check-in much later than occasional leisure travelers. Since these passengers usually pay higher fares denying boarding to these time-sensitive passengers would put future revenues at risk, as they might consider other airlines for their upcoming travel arrangements. Therefore to avoid, that valuable frequent flyers are affected of this procedure, based on passenger lists with customer relationship data, airline agents often do register valuable customers proactively even before they arrive at the check-in counter, if a flight appears to be heavily overbooked.

To profit from overbooking, airlines have to manage the trade-off between achieving additional revenues through higher load factors and the costs of denied boarding (i.e. compensation payments as well as the potential long term reputation damage). The optimal overbooking rate should therefore be set at the point, where the achievable net revenues, i.e. the gross revenues of sold tickets minus the expected overbooking costs, are the highest (cf. Figure 41).

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231 Cf. U.S. Department of Transportation (2008), p. 39
Traditionally, the benefit of overbooking is calculated by summing up the revenues which are gained on congested flights by selling more seats than available. A more differentiated view distinguishes between passengers that would have used another airline or would not have travelled in the absence of overbooking on the one hand, and passengers that would have used a different flight of the same airline or even a different fare class (e.g. Business Class instead of Economy) on the other hand. While overbooking allows for the generation of additional revenues in the first two cases, the latter two have a neutral or even a negative impact. Accommodating a passenger who is indifferent regarding the departure times of two equally priced flights on an overbooked flight instead of the alternative flight with ample capacity unnecessarily exposes the airline to the risk of having to deny boarding to a passenger of the overbooked flight (which results in compensation costs). Even more detrimental is the case where a passenger with a high willingness to pay that would have booked a higher fare in case of non-availability of cheaper tickets can purchase a cheap ticket due to the additionally offered capacity. This revenue cannibalization effect is referred to as “ticket sell-ups”.

In conclusion one can say that overbooking as a part of the YM process allows airlines to avoid empty seats on flights (spoilage) which in turn also benefits the passengers by spreading the costs of the flight over a larger customer base. From the airline perspective the main lever to optimize the trade off between additional revenues and denied boarding costs is an improvement of the forecast quality. Besides an extension of the considered data sources, two possible ways to achieve this goal which will be

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234 Cf. Suzuki (2006), p. 4
235 Curry (1990), p. 201
presented during the forthcoming chapters are risk pooling (i.e. combining the forecast of several flights) as well as a shortening of the forecast horizon (cf. chapter 3.3.2.).

### 2.5.3 Temporal peak-load balancing with Yield Management

In the course of forecasting the total demand for a particular flight based on historical data, airlines have to cope with the problem of strong deviations of the demand of particular flights in comparison to the average demand on a route. In empirical studies of demand time series of individual routes a relative standard deviation of 20% to 40% has been found.\(^{236}\)

Besides an overall year-to-year growth in European air travel\(^{237}\) airlines are also confronted with a strong seasonality in their business. While there are demand peaks during the summer months, airlines face demand slumps during the winter (with the exception of holidays such as Christmas or Easter). If, for example, all flights to and from Vienna are considered, passenger figures in January are 17% below the monthly average, while the figures of May exceed the average passenger volume by 12% (cf. Figure 42). To complicate things further, there are also differences on the route level. While touristic routes (e.g. Vienna-Antalya) are subject to heavy demand in the main holiday season, other routes that are mostly flown by business or connecting passengers (e.g. Vienna – Ljubljana) experience an inverse development (with August actually being the second weakest month). Smaller deviations can be found on routes that combine leisure and business travel, such as Vienna – London. Besides the underlying demand, the reported passenger figures are of course also influenced by the available capacity, which depends on the offered frequencies and the utilized aircrafts, as well as the chosen pricing strategy. In case an airline decides to maintain the offered capacity upright during the winter and to use discounted tickets to fill its seats, it can even out major demand differences at the expense of the average yield per seat (compare for instance the almost constant demand numbers on the Route Vienna – London Luton, which has been exclusively served by the LCC Easyjet, in contrast to the more fluctuating demand on the competing network carrier flights to London Heathrow).

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\(^{236}\) Cf. Belobaba (2006), ocw.mit.edu

\(^{237}\) From 2006 to 2007, for instance, the amount of passengers flown within, from or to the European Union grew by 7.3%, reaching a total of 793 million. Cf. Eurostat (2009), http://epp.eurostat.ec.europa.eu
Besides these monthly differences there are also strong differences in the demand for flights depending on the weekday. As shown in Figure 43, Passengers that travel for business purposes usually fly during the week with a peak on Friday, where 19% of all flights take place. On these days, there is strong preference for morning and evening flights. Leisure travelers also fly on the weekend, again with a peak on Friday afternoon and another one on Sunday evening. To match these demand differences, many airlines reduce their frequencies to typical business destinations during the weekend and employ the respective aircrafts on touristic routes instead (e.g. by operating charter flights on Saturday).

Figure 42: Differences in monthly passenger figures on various routes

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238 Cf. Eurostat (2010), epp.eurostat.ec.europa.eu
If several flights to one destination are offered per day, these are usually subject to strong intra-day differences in demand. Besides the differences that result from the wave structure of an airline (e.g. more passengers fly on feeder flight in case of large inter-continental flights in a particular wave), there are also strong differences in the demand for various departure times by business travelers. In order to be able to attend business meetings throughout the day, business travelers show strong preferences for early morning flights. If the destination allows a return on the same day and the airline offers at least a so-called “double daily” service, a second peak can be observed on evening flights. Table 15 shows the availability of various fare classes on a set of seven flights offered by Austrian Airlines and its partner Brussels Airlines from Vienna to Brussels on a weekday. As indicated in red, there are fewer seats available on the morning and the evening flights then on the remaining mid-day flights.

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Figure 43: Distribution of passenger demand onto weekdays

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240 Cf. Garrow / Jones / Parker (2007), p. 283. In this paper, the 'ideal departure times' for domestic US flights were analyzed, with the ideal times mostly lying between 7-10am as well as 6-8pm respectively.
<table>
<thead>
<tr>
<th>Flight times and capacity</th>
<th>Class</th>
<th>Economy</th>
<th>Business</th>
<th>Cheapest available fare</th>
</tr>
</thead>
<tbody>
<tr>
<td>Departure</td>
<td>Arrival</td>
<td>Seats</td>
<td>Type</td>
<td>Discounted (D.)</td>
</tr>
<tr>
<td>6:50</td>
<td>8:45</td>
<td>82</td>
<td>O</td>
<td>0</td>
</tr>
<tr>
<td>7:05</td>
<td>8:50</td>
<td>159</td>
<td>E</td>
<td>0</td>
</tr>
<tr>
<td>9:55</td>
<td>1:45</td>
<td>164</td>
<td>L</td>
<td>0</td>
</tr>
<tr>
<td>13:50</td>
<td>15:35</td>
<td>100</td>
<td>V</td>
<td>0</td>
</tr>
<tr>
<td>17:30</td>
<td>19:15</td>
<td>159</td>
<td>H</td>
<td>0</td>
</tr>
<tr>
<td>18:20</td>
<td>20:15</td>
<td>97</td>
<td>T</td>
<td>0</td>
</tr>
<tr>
<td>20:35</td>
<td>22:30</td>
<td>164</td>
<td>K</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 15: Availability of fare classes on various flights of one day

In the described volatile demand environment, Yield Management also serves as a tool to balance demand across several flights by giving price incentives. In the case of the variations on the flights from Vienna to Brussels, for instance, the less attractive afternoon flights (e.g. 13:50 => 15:35) are available for almost one third of the price of the heavily demanded morning flights. By decreasing prices for low-demand flights, some passengers are shifted away from peak-load flights (cf. the application of peak load balancing in case of weekly variations shown in Figure 44).

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241 Cf. Own analysis based on the fares quoted on the booking website of Austrian Airlines on 11.04.2010 (i.e. two weeks prior to departure on 27.04.2010). Availability for various booking classes based on SeatCounter (2010), www.seatcounter.com (since airlines do not disclose the exact fare availability numbers beyond the last nine seats, the numbers constitute the minimum amount of available seats in each class). Aircraft capacity data based on fleet information section on Austrian & SN Brussels airlines websites.
2.5.4 Pricing of different itineraries of one O&D

The fact that on the one hand, both, LCC and network carriers nowadays in many cases offer several different itineraries on a particular O&D within a certain time frame, and that on the other hand due to the widespread distribution of the internet potential customers can easily compare the fares of the offered flight alternatives, challenges the appropriateness of the assumption of most classical one-leg YM models, namely that the demand for a certain fare class of a particular flight is exogenous and independent from the demand for other classes or other flights. In order to better predict the phenomenon which Belobaba called ‘horizontal shift’, i.e. the booking of a seat in the same booking class on a different flight of the same airline due to the unavailability of the originally requested seat, recent YM concepts also aim at incorporating customer choice models: These models allow them to assume which flight alternative a customer would most likely choose, based on the offered prices of all flights at each of the considered time points of the selling horizon.

If different routing alternatives (e.g. direct flight, connection flight through hub A or connection flight through hub B) are available, yield management aims at increasing the overall profit by pricing the separate options differently, based on the expected demand and the marginal costs of the prevailing alternatives. One of the first authors to incorporate routing alternatives in a YM model has been Talluri. In his ‘Route-Set model’ (that he first presented as a working paper for USAir in 1993) he assumes that a fraction

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242 Own illustration
244 Cf. Zhang / Cooper (2005), p. 415f; Cf. Carrier (2007), p. 47ff, In modern YM systems such as PROS' O&D Solution tool, the demand for various flight itineraries and fares (also referred to 'Origin-Destination Itinerary Fare' or ODIF) is forecasted separately as a basis for the YM process.
of the customers is indifferent with regard to the route they take in order to get to their destination as long as the travel times and the quality are (almost) the same. He concludes that “large airlines with multiple hubs and alternative routes” can use the Route-Set model to reach “significant revenue enhancements, with almost no deterioration in the level of service, and a manageable increase in computational costs.”\(^{245}\) This revenue gain is attained since simultaneously managed multiple routings allow airlines to use price differentiation as a mean to deviate passengers onto flights with a relatively low load factor.

Taking the idea of routing control one step further, Gallego and Philipps presented a YM model that allows airlines to offer an unspecified ‘flexible product’ besides the existing set of specific products. As already mentioned in the introduction and further elaborated in chapter 4, flexible (sometimes also called ‘opaque’) products do not provide the customer with all product details (e.g. routing itinerary) at the time of purchase, which allows the airline to flexibly shift demand to low-demand itineraries at a later point in time (where more precise demand forecasts are available).\(^{246}\) Later works on this topic already mention that one way to make the incurred uncertainty more tangible to the consumer is “controlling […] the departure time windows for flights”\(^{247}\), an idea which serves as the basis for the proposed conditions of flexible time-range tickets (cf. chapter 4.4).

### 2.5.5 Challenges for Network Carrier Yield Management

Given the relatively long tradition of using RM in the airline industry, “customers seem to be used to the fact that they are charged different fares for the same flight and that they will receive specific benefits if they accept certain restrictions.”\(^{248}\) However, due to the increased fare differentiation measures that were made possible by more advanced IT-systems, many airlines have increased the usage of price discrimination during the last years to an extent that was in many cases no longer accepted by passengers who considered it unfair that the passenger sitting next to them only paid a fraction of their fare price.

> “Some efforts to take advantage of varying demand elasticities between market segments are also justified […]. However, it is now clear that in the past, Legacy carriers have taken these measures too far.”\(^{249}\)

Therefore, to some extent the popularity and the increase in market shares of LCC in comparison to network carrier can be attributed to their use of restriction-free pricing

\(^{245}\) Talluri (2001), p. 102; Cf. also Müller-Bungart (2007), p. 117
\(^{246}\) Cf. Gallego / Philipps (2004), p. 321ff
\(^{247}\) Jiang (2007), p. 131
\(^{248}\) Shaw (2007), p. 193. This discomfort of passengers is also described by Kimes (2002, p.21): “A customer who pays more for a similar service and cannot perceive a difference in the service may view the situation as unfair. If customers view yield management as unfair, the increased revenues resulting from yield management may be short-term.”

\(^{249}\) Talluri (2001), p. 102.
(RFP) schemes, which allow travelers to book and combine one-way flights without being restricted by rate fences.

To stay competitive against the restriction-free pricing (RFP) models of LCC many NC have selectively relaxed their rate fences by offering more discount tickets on routes where they face intense price competition. An example for this behavior can be seen with regard to the offering of so-called “Red Tickets” (discount fares) on selected direct flight routes from Austrian Airlines (cf. Table 16). Besides the differences in the fare level as such, there is also a strong dependence between the intensity of competition and the use of length of stay restrictions.

<table>
<thead>
<tr>
<th>Competition intensity</th>
<th>Destination (from Vienna to)</th>
<th>Total number of daily flights (carriers)</th>
<th>Offered fare (Economy Class return fare incl. all applicable taxes, length of stay: 8 days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOW</td>
<td>Iasi (RO) 105min travel time</td>
<td>1 (OS)</td>
<td>No Red Tickets available; Cheapest fare 590,63 € Restrictions: min. stay: 6 nights or Saturday night</td>
</tr>
<tr>
<td></td>
<td>Barcelona (ES) 150min travel time</td>
<td>3 (OS, NE)</td>
<td>Red Tickets available; Cheapest fare: 151,34 € Restrictions: min. stay: 2 nights or Saturday night;</td>
</tr>
<tr>
<td></td>
<td>Bucharest (RO) 105min travel time</td>
<td>7 (OS, RO, NE)</td>
<td>Red Tickets available; Cheapest fare: 98,13 € Restrictions: min. stay: 1 night</td>
</tr>
<tr>
<td>HIGH</td>
<td>Berlin (DE) 70min travel time</td>
<td>12 (OS, LH, AB)</td>
<td>Red Tickets available; Cheapest fare: 98,29 € Restrictions: NO min stay rule applicable!</td>
</tr>
</tbody>
</table>

Table 16: Intensity of competition and the availability of discount fares

In markets with a higher penetration of LCC (e.g. USA, UK or Ireland), many airlines were even forced to go further in their reactions to the pricing strategies of new-entrants and started to adopt RFP on some routes.

“In markets where simplified fares become commonplace, other carriers must follow this direction in order to remain competitive.”

As a result three different pricing strategies can currently be observed on the market:
- Pure RFP as applied by LCC as well as hybrid airlines (e.g. Air Berlin) and some network carriers (e.g. British Midland, Air Baltic or Air Lingus).

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250 Own analysis based on the fares quoted on the website of Austrian Airlines on 07.12.2008 (i.e. two months prior to departure). Departure date: 10.02.2009, return date: 18.02.2009. OS = Austrian Airlines; NE = Sky Europe; RO = Tarom Romanian; LH = Lufthansa; AB = Air Berlin.

251 Ratliff / Vinod (2005), p. 304f. This transition often becomes necessary because traditional yield management techniques no longer work properly in addressing the high-yield segment and the airlines see themselves confronted with selling the majority of their seats in discount fare classes. As the responsible yield manager at the airline British Midland puts it, “the objective of the change was to help halt the decline in traffic, stimulate new volume and steal market share from other carriers. In addition, it was hoped that the new fares structure would reduce the polarisation of class mix from 70 percent in the bottom three classes to a more even spread.” (Donelly / James / Binnion (2004), p. 11).
Selective use of RFP and classical rate fences. Examples include the former European flag carriers British Airways or SAS as well as many US network carriers, which sell their short-haul seat inventory on a RFP-basis while still maintaining some rate fences on long-haul flights.

Classical revenue management of return flights is still used by the majority of network carriers. However, as shown above, the use of rate fences is often strongly diminished on routes where NC face competition by LCC.

This typology is likely to permanently change in the future towards a less restrictive pricing scheme. “At this point, it seems unlikely that the FSNCs [Full-Service Network Carriers] can re-impose the degree of price discrimination they once enjoyed.” While this gives more freedom for consumers that appreciate the possibility to join flights from different carriers in order to build their ideal round-trip, it impedes airlines in segmenting the market by means of traditional rate fences (e.g. Saturday night rule, minimum or maximum stay requirements, etc). The lack of these fencing mechanisms would for instance allow a business traveler, who requires a flight that returns on the same day, to purchase the same outbound fare as a leisure traveler, who spends the weekend at the destination, as long as they both book at the same time. As a result, it is likely to assume that the move to RFP-schemes is not going to stop but rather to speed up the decline of yields, which has triggered the development of new YM-methods. In a RFP-environment, the main questions to solve are, how large the available booking class should be and when it should be closed (either after a specified amount of bookings or a certain number of days prior to departure).

RFP also has an impact on the demand forecast models that form the basis of YM since it “led to a violation of the assumption of independence of demand between fare classes, which is implicit in most commonly used forecast systems.” Newer approaches therefore aim at extending the data sources that are used in the forecasting process to actual booking requests, which can be seen as a representation of the overall market demand. By comparing the conversion rate of a particular flight (i.e. actual bookings relative to the number of booking requests) to average conversion rates of similar flights an airline can also determine whether the offered fare for a specific flight is too low or too high (which would be the case if an unusually low conversion rate is observed).

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252 Tretheway (2004), p. 8
254 Zeni (2007), p. 312. While in the classical YM system, a traveler with certain date and time requirements (e.g. return flight on the same day) was forced to buy a corresponding tariff class, irrespective of the demand in other fare classes, in a RFP-scheme where fare classes are consecutively filled up (starting with the cheapest) the accuracy of the forecast for the most expensive fare class depends on the forecast quality of all underlying classes. If airlines that extensively use low fares as a marketing tool do not adjust their forecasting models (that are usually based on historical data) they might even be subject to the so-called ‘spiral-down effect’. This effect occurs, if customers that would have been ready to buy high fare classes (if necessary) switch to low fares, which then results in an underestimation of high-yield demand in the next period (based on historical data). If this leads to an adjustment of the offer of low-fare seats, the spiral-down effect amplifies further, since even more travelers with a high willingness-to-pay are then able to purchase low-fare tickets.
Other levers for revenue improvement are more accurate overbooking policies which can be realized based on the fact that RFP leads to a lower No-Show rate (for instance, by not incentivizing customers to buy a return ticket in order to get a cheaper fare, if they only need an outbound flight) that allows to improve the forecast quality.\textsuperscript{256} However, “even with advanced Revenue Management methods, it may not be possible to completely overcome the significant yield losses associated with a move from restricted to unrestricted fares.”\textsuperscript{257}

In order to be able to maintain their revenue situation in the new RFP environment, network carriers are looking for new approaches to target the low-cost segment without risking a cannibalization of high-yield revenues, or as Garrow puts it in a review of current changes in the YM landscape: “Conceptually, the fundamental question of interest is to determine whether it is possible to stimulate new leisure demand by designing a product for highly time-flexible travelers that is sold via the Internet.”\textsuperscript{258} In this environment, flexible time range tickets are one possible solution to address the yield management challenge currently faced by network carriers, which, after a theoretical overview of risk handling strategies in the following chapter, is presented in chapter 4.

\textsuperscript{256} Cf. Donelly / James / Binnion (2004), p. 16
\textsuperscript{257} Ratliff / Vinod (2005), p. 304f
\textsuperscript{258} Garrow (2009), p. 252
3 Decision making under risk and uncertainty

In a normal purchasing situation, a consumer evaluates the ascribed utility of the desired product with the quoted price – if the monetary value exceeds the price the product will be purchased. In many cases though, the attainable utility cannot be fully assessed at the moment of purchase, which forces the consumer to make assumptions about the expected utility. Flexible products are a special case, where consumers are by definition of the product forced to make a purchase decision under uncertainty, since it is not clear, to which of the available product alternatives they will ultimately be assigned. Therefore in order to be able to better understand the behavior of consumers when confronted with uncertain outcomes, the purpose of the following chapter is to provide an overview of existing theories of the decision making process under risk and uncertainty. After a short clarification of relevant terms, first the issue of consumer decisions and second the subject of corporate risk management will be addressed.

3.1 Basic terminology

According to Webster’s Dictionary, the term ‘uncertain’ designates something that is “not certain to occur”, with certain being defined as something “fixed” or “known”. By some scholars the term has further been divided into knowledge and choice uncertainty, with the first describing a lack of information about available alternatives, while the latter refers to situation where a person is uncertain about which alternative to choose.

The term ‘risk’ originates from the Italian and means ‘to hazard something’. It is used to describe the possibility of deviations from an expected, but uncertain, outcome. Interestingly though, usually only negative deviations are defined as risk.

An early attempt to clearly distinguish uncertainty and risk has been made by Knight in his monograph “Risk, Uncertainty and Profit”.

“The essential fact is that ‘risk’ means in some cases a quantity susceptible of measurement, while at other times it is something distinctly not of this character; [...] It will appear that a measurable uncertainty, or ‘risk’ proper, as we shall use the term, is so far different from an unmeasurable (sic!) one that it is not in effect an uncertainty at all. We shall accordingly restrict the term ‘uncertainty’ to cases of the non-quantitative type.”

As this definition builds upon the measurability of an uncertainty – or put differently, upon its probability of occurrence – Knight also proposes a distinction of three kinds of probabilities:

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259 Merriam-Webster’s (1994)
262 Knight (1933), p. 19f
A priori probabilities can be logically derived (e.g. there is a 50% chance that a thrown coin lands on one specific side)

Empirical probabilities can be measured ex-post (e.g. the average probability of rainfall in a certain area in a specific year)

Estimates are given without any valid empirical or logical basis and rely on judgments of the individual.\(^{263}\)

As Knight indicates with the term ‘empirical probabilities’, risk can be considered differently, depending on whether a single event or a series of events is looked at.

“The fact is that while a single situation involving a known risk may be regarded as ‘uncertain’ this uncertainty is easily converted into effective certainty; for in a considerable number of such cases the results become predictable in accordance with the laws of chance, and the error in such prediction approaches zero as the number of cases is increased. Hence it is simply a matter of an elementary development of business organization to combine a sufficient number of cases to reduce the uncertainty to any desired limits. This is, of course, what is accomplished by the institution of insurance.”\(^{264}\)

This already indicates a fundamental information difference regarding uncertainty between consumers and corporations. While consumers – unless they are more often confronted with comparable situations of uncertainty or have access to statistical data about the probability of occurrence – have to rely on individual judgments, corporations can in many cases of alleged uncertainty build upon their own experiences from previous cases in order to empirically judge the probability of occurrence. This allows the latter to manage risk more actively than consumers can do.

Other approaches towards a classification of uncertainty build upon the type of reasonably imaginable outcomes. While still accepting uncertainty, such a classification allows an economic agent to select appropriate simulation techniques in order to properly assess an incurred uncertainty. According to the possible futures, Courtney for instance distinguishes between a single view of the future, several possible alternatives, a range of outcomes or true uncertainty where no alternative can be excluded (cf. Figure 45).\(^{265}\)

\(^{263}\) Cf. Knight (1933), p. 224f

\(^{264}\) Knight (1933), p. 46

\(^{265}\) Cf. Courtney (1963), p. 22
3.2 Consumer decision theories

In order to better understand the decision making process of consumers, in the following, the main theories from economics as well as marketing research will be presented.

3.2.1 The classical expected utility theory

The term 'classical theory' designates a set of economic theories, mainly from the 19th century, which with regard to the explanation of individual behavior are centered around the notion of the Homo Economicus (also called Economic Man). The Homo Economicus is assumed to act rational and self-interested with the aim of maximizing his own utility. Furthermore he has fixed preferences and disposes of complete information, which also allows him to react to given restrictions.\(^\text{267}\) Regarding the aim of maximizing utility it has to be noted though that although in economics this goal is usually measured on monetary terms, a target function of an individual could for example also be the maximization of spare time (which can be assigned a monetary value).

Such a rationally acting individual is selecting between two alternatives based on their expectancy value. When confronted with an uncertain alternative the expected outcome is derived and compared to a certain outcome. In this setting, the safety equivalent designates the certain outcome that an individual would be willing to exchange against an uncertain alternative. Given a 50% chance to win €100, the safety equivalent (for risk-neutral deciders) would be €50.\(^\text{268}\)

Bernoulli has been the first to amend this principle by accommodating individual preferences in the perception of an expected utility. He argued that the pure 'mathematical' outcome is quantified differently by individuals based on specific risk utility functions as well as their former wealth (leading to the consideration of a decreasing marginal utility). Von Neumann and Morgenstern added a set of axioms to

\(^{266}\text{Cf. Franz (2004), p. 4 ff.}\)

\(^{267}\text{Cf. Blitcz (1981), p. 88ff}\)
foster the theory in 1944, which was a few years later also taken up by Friedman and Savage. They assume a unidirectional underlying function which can be used to translate the expected (monetary) gains into an individual expected utility. As demonstrated in Figure 46, this function allows for the classification of an individual as risk averse (if the utility of an additional gain x is valued smaller than the potential loss of x) or risk seeking (if the utility of a potential gain is valued higher than a monetarily equivalent loss of the same amount).

![Figure 46: Risk averse & risk seeking behavior according to the expected utility theory](image)

Building upon the risk utility function, it is also possible to calculate the compensation that someone would have to be given in order to accept a high-risk alternative (such as for instance a flexible flight ticket). For risk averse consumers, the safety equivalent is always lower than the expectancy value, which means that an individual is willing to accept a lower gain (equal to higher costs) in case this results in a smaller incurred risk.

Since some of the underlying assumptions of classical utility theories are only seldom found in real-life situations, several new concepts were developed during the last years to overcome this limitation, which will be discussed in the following chapter.

### 3.2.2 The prospect theory – a behavioural economics approach

Behavioural economic theories have in common that they challenge the central assumption of the classical theory, which postulates that consumers act totally rational with the aim of maximizing their utility. In contrast to this assumption, behavioral theories limit the rationality of consumers to a ‘bounded rationality’, which accepts that consumers have limited ability and willingness to absorb and process information about the potential result of uncertain alternatives. Furthermore in many cases they also

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272 Cf. Pohl (2004), p. 49f
accept the presence of preferences, the ability of the consumer to (selectively) recall prices and the possibility that a decision making process spans over a long time, involving several phases (instead of an instantaneous reaction).\textsuperscript{273}

Two scholars that used hypothetical choice experiments to challenge the classical utility maximizing principle were Kahnemann & Tversky. In several experiments they have asked a large number of students to decide between a safe win of a certain value $x$ and a risky prospect with a higher \textit{expected} value $y$ (e.g. 50\% chance to win an amount that is more than twice as high than $x$). They found that instead of a rational selection of the higher expected value $y$, most respondents decided in favor of the safe prospect $x$, thereby showing risk averse behavior.\textsuperscript{274} Other experiments have confirmed that when confronted with a 50\%-50\% chance of losing or gaining money, most respondents reject the offer, as long as they cannot win at least twice the amount that they might lose.\textsuperscript{275}

Based on these findings, Tversky and Kahneman developed the prospect theory to explain customer behavior in a situation of uncertainty. They assume that customers compare expected utility gains or losses of a new alternative in comparison to the status quo that defines the reference level for all considered product attributes. Through several experiments they demonstrate that people tend to overweight certain outcomes relative to outcomes which are only highly probable, a phenomenon which they call "certainty effect."\textsuperscript{276}

\begin{quote}
"Many decision problems take the form of a choice between retaining the status quo and accepting an alternative to it […]. The advantages of alternative options will then be evaluated as gains and their disadvantages as losses. Because losses loom larger than gains, the decision maker will be biased in favor of retaining the status quo."\textsuperscript{277}
\end{quote}

These assumptions result in a concave curve for gains and convex curve for losses which originate at the reference point.

\textsuperscript{272} Cf. Simon (1957), p. 198ff; Pohl (2004), p. 74
\textsuperscript{274} Cf. Kahneman/Tversky (1979), p. 263f
\textsuperscript{276} Cf. Kahneman / Tversky (2000), p. 20
\textsuperscript{277} Kahneman / Tversky (2000), p. 13
Based on the prospect theory therefore, in order to be accepted by an individual customer, the price discount of flexible time-range tickets has to be valued higher than the fact that exact travel details are unknown at the moment of purchase.

### 3.2.3 Risk management of consumers

As pointed out above, people tend to act risk averse. In a confrontation with a risky situation, consumers will make assumptions about the probability of occurrence and the potential damage in order to decide whether they will pursue or stop an activity. When looked at more specifically, one can therefore on the one hand distinguish the case where a risk is tolerated, i.e. the expected gains make it worth to put risk reducing measures in place in order to be able to pursue an activity, while on the other hand there are cases, in which a risk is deemed small enough to accept it without the need for risk reduction.

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278 Adapted from Kahneman / Tversky (1979), p. 279
279 Cf. Renn (2008), p. 149
The relation between these dimensions is illustrated in Figure 48, which also shows the case where either the potential damage or the probability of occurrence are considered too high to accept a specific risk (red area).

![Figure 48: Risk diagram](image)

The diagram illustrates the need for a consumer to assess a risk according to the two mentioned dimensions (risk characterization) and eventually to take the required measures to either bear, reduce or avoid the risk (risk evaluation).

### 3.2.4 Marketing research

Since it is of high importance for marketers to understand how consumers judge different, sometimes new product alternatives, their purchasing decision making process became one of the main research topics of this field.  

A widespread model geared at the description of consumer behavior distinguishes three process steps, namely perception of a stimulus, analysis by an organism, and finally a reaction of the acting agent. In short the term stimulus – organism – reaction (SOR) model is used. While stimuli (e.g. confrontation of a potential buyer with a product offer or an advertisement) and reactions (e.g. purchase or rejection) can be measured, the actual decision process takes place inside the organism and is therefore only indirectly graspable. The main components of this process can either be activating ones

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280 Cf. Renn (2008), p. 150  
283 Cf. Bänsch (1996), p. 4
(e.g. emotions, motivations and attitudes) or cognitive ones (e.g. perception, learning, decision-making, remembering).284

The role and the weight of the various components differ according to the type of a purchase decision. In contrast to simple, repeated or impulsive purchases, more complex products (such as an airline ticket) require an extensive decision process which mostly relies on cognitive components.285 In a complex purchasing decision, a consumer will be confronted with a perceived risk to choose the wrong alternative. As already pointed out above, this risk can be conceptualized by a consumer by evaluating the potential damage resulting from the selection of the wrong alternative and the probability that this damage actually occurs. Potential damage could be of financial (e.g. too high price), functional (fear that the purchased good does not serve the expected purpose), psychological or social (lack of appreciation by others) nature.286

The larger the perceived risk, the more willing is a consumer to search for additional information. Since this results in additional costs for the consumer (time costs) companies should aim at providing their potential customers with the relevant information as simply as possible. Relevant information sources are among others sales materials (e.g. company website) and conversations, advice from friends, advertisements and independent information sources such as magazines or internet sources.287

If even through an extended information search, the perceived risk cannot be lowered below an individual tolerance limit, consumers will apply risk reduction techniques. These can either aim at reducing the feared negative consequences or at abolishing the suffered insecurity. Possible measures would be the purchase of (smaller) sample packages prior to purchasing a large amount, the selection of a product that is certified by a third party (e.g. in Germany the TÜV-seal of quality), the purchase of a known brand product or even the selection of the most expensive available alternative. Companies can furthermore decrease perceived risk by offering guarantees or return rights to their customers.288

In case that the consumption of a product takes place at a later point than the purchase (as it is usually the case with airline tickets), a consumer might even suffer of cognitive dissonance, after a purchase. In this case he or she questions the purchase of the selected alternative, which might ultimately result in a cancellation of the purchase. Therefore, especially in situations with a high perceived risk, companies should aim at a reduction of customer uncertainty also after the purchase (e.g. by assuring customers that they have selected a great product).289

3.3 Corporate risk management

3.3.1 Introduction to risk management

Since companies regularly have to take decisions which affect their future, they are also confronted with risk and uncertainty. However, as they are able to spread their risk over several cases (which based on the law of large numbers makes it easier to quantify it) or can invest more time into forecasting the future, they can in many cases determine the probability of occurrence better than consumers. Therefore, in the following chapter the focus will be laid on situations of risk (in contrast to decisions under true uncertainty).

Risk management is a process that supports companies in evaluating anticipated revenues with associated risks in order to enhance the decision making process. By clarifying the components and the complexity of certain risks it provides companies with a viable basis to handle risks more effectively.\textsuperscript{290} Figure 49 illustrates the main steps of the risk management process.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure49.png}
\caption{Risk management process\textsuperscript{291}}
\end{figure}

As shown above risk management consists of four successive, but interlinked phases:

1. Risk identification consists of the systematic registration of risks, their potential damage as well as possible interdependencies.
2. Risk assessment includes the evaluation of the detected risks by assessing their probability of occurrence as well as their potential effects.
3. Risk handling designates all actions taken by a company to optimize their risk exposure. The goal of this step is not to eliminate risks but rather to reduce the degree of risk exposure to an acceptable residual risk level. As described below.

\textsuperscript{290} Cf. Gleißner (2008), p. V
\textsuperscript{291} Cf. Veselenak (2009), p. 60
and shown in Figure 50 there are several possible strategies to achieve this goal.

4. Finally to account for changing goals and environmental conditions the risk management process has to be regularly revised. The outcome of this revision can either be the discovery of new risks (which then undergo the entire risk management process) or a different assessment of risks or risk handling measures (e.g. detection of an over-insurance of risks or not sufficiently managed risks). 292

Based on the taken risk assessment companies have four main options to handle risk. 293

**Figure 50: Risk handling strategies** 294

Risks which are deemed to be too dangerous and cannot be reduced or transferred are avoided. Examples could be to refrain from a business because it might result in unbearable consequences. Where possible, risks can be reduced by taking proactive steps to either reduce the probability of occurrence or the potential damage involved with an activity. Examples would be regular maintenance of assets or the diversification of activities. At the point where a certain risk cannot be further reduced, a company can decide to transfer the risk to a third party. While this usually does not influence the probability that an event takes place, it can decrease the potential damage that a party incurs. The most used measure to transfer risk (by companies or consumers) is the purchase of an insurance contract. Finally, if a risk cannot be transferred or the costs for a transfer are considered too high by a company it can decide to bear a remaining residual risk. This is usually also done with risks that are not properly identified by a company.

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294 Cf. Gleišner (2008), p. 159
3.3.2 Forecasting as a basis for managing operational risks

Several processes in the airline industry are heavily depending on a good forecast of passenger demand. While on a strategic level, network planning builds upon projected Origin-Destination demand for various fare classes, on a tactical and operational level Yield Management requires as accurate as possible forecasts to allocate capacity units (seats) to arriving booking requests in order to maximize the overall revenue. In the following, the main applied forecast methods to cope with demand uncertainty will be presented. In most cases a combination of quantitative (mostly naïve) and qualitative forecast methods are employed.

"The term naïve may be applied to any forecast obtained solely from historical values of the variables to be forecasted."\(^{296}\)

Therefore the simplest available “forecast” method would be an unchanged projection of the last observation of a variable for future points in time. More complex methods do not only rely on a single observation in the past but do take several data points into consideration, e.g. by building a moving average of past observation values. Further advanced time-series analysis methods do also consider trends and seasonality by incorporating adjustment factors (see example below). Due to the fact that they are building upon several (additive or multiplicative) components, they are referred to as component models. An additive component is used if a trend is rather constant in absolute numbers (e.g. the number of worldwide airline passengers grows by an additional 100 Mio. passengers each year), while a multiplicative component can be used to accommodate the fact that certain periods always show a different level in proportion to a changing absolute base number (e.g. an airline always transports 1.4x as many passengers in July than in an average month).\(^{297}\)

\[
\hat{x}_{t+i} = (a_t + i b_t) * s
\]

with: \(\hat{x}_{t+i}\) = forecasted value \(a_t\) = base value (e.g. last observation) \(i\) = forecasted periods \(b_t\) = absolute trend adjustment factor \(s\) = multiplicative seasonality

If there is an influence of several independent (exogenous) variables onto the dependent (endogenous) variable, a multivariate forecast model should be used. To obtain valid results, the variables entering a model should have a logical, i.e. causal relationship to the forecasted variable (e.g. the presence of state holidays is assumed to positively influence the demand for flights on these days). In order to be able to forecast future values of the dependant variable, the input variables should either be already available at an earlier point of time (e.g. holidays are usually known several months or even years ahead) or at least be easier to estimate than the target values. The most prominently used multivariate forecasting method is linear regression analysis, which

\(^{295}\) Cf. Doganis (2002), p. 208: “Forecasting is the most critical area of airline management”
\(^{296}\) Chrisholm / Whitaker (1971), p. 8
assumes a linear function between the weighted input factors and the predicted variable (see example below).\textsuperscript{298}

\[ x_t = a_0 + b_1 y_{1t} + b_2 y_{2t} + \ldots + b_n y_{nt} + e_t \]

<table>
<thead>
<tr>
<th>with:</th>
<th>( x_t ) = value of dependent variable at time ( t )</th>
<th>( a_0 ) = (any) constant term</th>
<th>( b_1, b_2, b_n ) = parameters</th>
<th>( y_1, y_2, y_n ) = independent variables</th>
<th>( e_t ) = error term</th>
</tr>
</thead>
</table>

By comparing the correlation between the predicted and the actual value (usually denominated by the coefficient of determination, \( r^2 \)) the goodness of fit of the model can be calculated, telling the researcher how much of the variance of the dependent variable is explained by the independent variables. The initial calibration of the model is done via a trial of several weight parameters with the aim of minimizing the sum of squared error terms of the entire regression function (method of least squares).\textsuperscript{299}

To assess the quality of a forecast (or the forecast error) a range of metrics can be used, of which two widely used ones, the Mean Absolute Deviation (MAD) and the Mean Squared Deviation (MSD), will be presented in the following. While in both cases the deviations between estimator and actual value are scrutinized, with the latter more weight is given to large deviations (since the residuals are squared, large errors receive proportionally more attention than small ones). To present the forecast error as a relative measure, the mean absolute percentage error (MAPE) can be used.\textsuperscript{300}

\[
\text{MAD} = \frac{1}{T} \sum_{t=1}^{T} | x_t - \hat{x}_t | \\
\text{MSD} = \frac{1}{T} \sum_{t=1}^{T} (x_t - \hat{x}_t)^2 \\
\text{MAPE} = \frac{1}{T} \sum_{t=1}^{T} \left| \frac{x_t - \hat{x}_t}{x_t} \right|
\]

<table>
<thead>
<tr>
<th>with:</th>
<th>( \hat{x}_t ) = forecasted value (estimator)</th>
<th>( x_t ) = actually observed value</th>
<th>( T ) = total number of forecasted periods</th>
<th>( t=1 ) = first forecasted period</th>
</tr>
</thead>
</table>

High forecast accuracy is of great importance for airline revenue management. Having examined data from several high-demand flights of US airlines, Lee reports an increase of 0,5% - 3% in average revenues for every 10% increase in forecast accuracy.\textsuperscript{301} These findings were also confirmed in a simulation study by Belobaba and Weatherford.

"The greatest impacts were observed when the fare class demand forecasts proved to be inaccurate. Demand forecasting errors of 25% for each fare class, not an outrageous magnitude in yield management practice where the demand for

\textsuperscript{298} Cf. Hansmann (1983), p. 126ff; Chrisholm / Whitaker (1971), p97
\textsuperscript{299} Cf. Schlittgen / Streitberg (1984), p. 16
\textsuperscript{300} Cf. Hansmann (1983), p. 15
\textsuperscript{301} Cf. Lee (1990), p. 255
a single fare class can be of the order of 10-20 passengers, were simulated to have negative revenue impacts of 1-2% or more on the highest demand flights.\(^\text{302}\)

Two factors which have a strong influence on the forecast error are the forecasted time span as well as the spatial and temporal aggregation level of the forecast. In a survey among 160 managers from the US that were responsible for demand forecasts, Cox & Mentzer found a strong correlation between forecast horizon, aggregation level and forecast error. This has also been confirmed by Fildes and Beard who conducted several case studies with British manufacturing companies (cf. Table 17). Although with higher MAPE-error figures, results following the same logic were also obtained in studies dealing with the airline\(^\text{303}\) or the hotel industry.\(^\text{304}\)

<table>
<thead>
<tr>
<th>Aggregation level</th>
<th>&lt; three months</th>
<th>&lt; two years</th>
<th>&gt; two years</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Product group</strong></td>
<td>10% (10%)</td>
<td>15% (10%)</td>
<td>20% (15%)</td>
</tr>
<tr>
<td><strong>Product line</strong></td>
<td>11% (12%)</td>
<td>16% (12%)</td>
<td>20% (19%)</td>
</tr>
<tr>
<td><strong>Product</strong></td>
<td>16% (16%)</td>
<td>21% (20%)</td>
<td>26% (27%)</td>
</tr>
</tbody>
</table>

Table 17: Influence of aggregation level & forecast period on forecast error\(^\text{305}\)

If companies require a forecast for individual items as well as item groups, often a hierarchical forecasting process is used. Within such processes, two distinct approaches can be distinguished, namely the bottom-up as well as the top-down approach.

- In the bottom-up process, the demand for individual segments (e.g. specific Stock-Keeping Unit, a single day or a single sales entity) is forecasted and later on aggregated to a cumulative forecast of the demand for the superordinate entity.

- If the demand of forecasted products follows similar patterns, in order to reduce the time and the costs involved with individual forecasting, companies can apply a top-down approach. In this case aggregate demand is predicted and later on disaggregated on the basis of historical segment proportions to produce a so-called derived forecast for each segment.\(^\text{306}\)

Based on these fundamental characteristics of forecasts several risk reduction strategies (e.g. postponement) have been built up which will be presented in the next section. Furthermore these characteristics also form the basis for the cost reduction and

\(^{302}\) Belobaba / Weatherford (2002), p. 820

\(^{303}\) Cf. Sa (1987), p. 81

\(^{304}\) Cf. Kimes (1999), p. 1106f. Having examined the group arrival forecast accuracy of hotels, Kimes found that “the MAPE averaged 40% at two months before arrival, dropped to about 30% at one month before arrival, and decreased to 10-15% on the day of arrival.”


\(^{306}\) Cf. Caniato et al. (2005), p. 480
demand induction potentials that come along with the use of flexible tickets in the airline industry, which will be presented in more detail in chapter 4.

3.3.3 Presentation of selected demand risk reduction strategies

Due to its intangible nature, passenger air transport clearly qualifies as a service. However, with regard to another quality, which is often attributed to services, namely the inability to store a service, the picture is not that clear cut. Traditionally, taking a narrow perspective, transport is considered as a non-storable product.

“Transport services are [...] perishable. In other words they cannot be stored.”

While this might hold true for the actual transportation process as such, there is more flexibility regarding the possibility to store transport objects (i.e. goods, passengers or news). With the exception of express goods it is normally unproblematic to store transport goods if this allows for a more efficient transportation. Within limits the same can be said of passengers, who are often willing to accept waiting times in return for a cheaper fare.

Since the concept of flexible time-range tickets also builds upon this option to temporarily “store” customer demand, in the following section the main functions and benefits of storage (inventory management) as well as the strategy of postponement will be discussed. It will be shown that both concepts are effective measures to reduce demand risk.

3.3.3.1 Risk reduction by means of inventory Management

The main purpose of holding inventory is the ability to deal with unexpected changes in customer demand or disruptions in the supply chain, i.e. to bridge time disparities between actual and desired in- or outflow of goods. A broader overview of various functions of inventory is given in Figure 51.

![Figure 51: Inventory functions](image)

Besides the already mentioned adjustment and security function (by means of a so called safety stock) the following benefits can be identified:

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307 Gubbins (2003), p. 111
• Cost reduction: By storing goods, companies are able to purchase larger quantities from suppliers (at lower prices) and can achieve larger production or transportation lot sizes, which in turn results in lower costs per unit (economies of scale)

• Speculation function: If a company expects price changes in relevant markets (e.g. higher price for supply goods) it can build up inventory to hedge against or even profit from this development.

• Production function: In some cases, products have to be stored for technical reasons during the production process (e.g. fermentation, desiccation, or ripening).

• Sorting function: In case various components sequentially share a production step, it can be necessary to temporarily store some, in order to reduce setup costs.

• Provision function designates the situation, where product storage and presentation to the customer are happening at the same time (e.g. supermarket shelves).311

When serving a geographically widely dispersed range of customers, a company has to decide whether it operates a central warehouse, several regional ones or a mixture of these models. Thereby the trade-off between increased transportation costs in case of central warehouse location (due to in average longer transport for customer shipments) and larger inventory management costs in case of several warehouses has to be managed. If the demand of various market regions is independent of each other, a supply chain that uses several warehouses would in total also require a larger safety stock than a company that uses a single, central warehouse. The difference can be calculated by multiplying the required safety stock of one location with the radical of the number of warehouses.312

\[ S_n = S_1 \times \sqrt{n} \]

with:

- \( S_n \) = total safety stock with \( n \) warehouses
- \( S_1 \) = safety stock with one warehouse
- \( n \) = total number of warehouses

This effect is also referred to as risk pooling and forms the basis for the postponement concept, which will be presented in the subsequent chapter.

“Risk pooling suggests that demand variability is reduced if one aggregates demand across locations because, as we aggregate demand across different locations, it becomes more likely that high demand from one customer will be offset by low demand from another. This reduction in variability allows a decrease

in safety stock and therefore reduces average inventory. Intuitively, the benefit from risk pooling decreases as the correlation between demands from the two markets becomes more positive.\(^{313}\)

Besides pooling risk across geography, other options include risk pooling across time (e.g. merging seven daily delivery tours into a larger weekly tour is expected to decrease volatility of the encountered load factor), risk pooling across products (e.g. the demand for an entire product family is less volatile than the demand for a single item) or across capacity (if for instance several factories can be used to produce a particular product, this allows the company to better balance capacity shortcomings).\(^{314}\)

### 3.3.3.2 Risk-Pooling using a postponement strategy

When setting up a production strategy, a company has to decide at which point of its production process it links formerly unassigned products (which were produced based on expected customer demand) to actual customer orders. This “customer order decoupling point, or as it is sometimes called, the order penetration point, [...] can be looked at as the point at which demand changes from independent to dependent.”\(^{315}\) Depending on the step of the production process at which this unbundling takes place, a range of production designs can be identified, which are illustrated in Figure 52.

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**Figure 52: Various Customer Order Decoupling Points (DP)**\(^{316}\)

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\(^{315}\) Vollmann / Berry / Whybark (2005), p. 19

\(^{316}\) Own illustration, based on Vollmann / Berry / Whybark (2005), p. 20
The selection of a suitable production layout depends on the industry, the product as well as the demand situation. Factors which have an influence on the position of the customer order decoupling point can be grouped into market-related, product-related and production related ones (cf. Table 18).
### Market-related factors and requirements

<table>
<thead>
<tr>
<th>Factor</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delivery lead-time</td>
<td>In case a quick delivery is required by the market, the DP should be set at a later production stage (especially with long production lead times).</td>
</tr>
<tr>
<td>Product demand volatility</td>
<td>The lower the demand volatility, the better the forecast quality, which allows producing goods based on forecasts (MTS). Factors which impact volatility are the absolute size and the frequency of customer orders (regularly occurring small orders are easier to predict than seldom large orders).</td>
</tr>
<tr>
<td>Product diversity and customization</td>
<td>The more a production process is based on individual customer specifications (e.g. design and construction of a house) the earlier the DP, the more generic a product (e.g. noodles) the later the DP.</td>
</tr>
<tr>
<td>Seasonal demand</td>
<td>If seasonal demand peaks can be anticipated, it makes sense for a company to produce certain products (which usually are MTO or ATO) already in seasons of low demand (MTS), in order to achieve a more leveled plant utilization throughout the year.</td>
</tr>
</tbody>
</table>

### Product-related factors

<table>
<thead>
<tr>
<th>Factor</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modular product design</td>
<td>To achieve a short lead time and various product options, companies can use an Assembly-to-order design.</td>
</tr>
<tr>
<td>Possible customization</td>
<td>If the customization offered is wide and enters the product at early production stages, an MTO policy is necessary, whereas if customization enters at a very late production stage ATO may be more appropriate.</td>
</tr>
<tr>
<td>Material profile</td>
<td>The structure of the material flow (e.g. linear, convergent, divergent or mixed)(^{317}) has an impact on the production design. For instance, with a diverging material profile, often an ATO strategy is used where a generic pre-product is produced based on forecasts, while the specification of the final product is made based on orders.</td>
</tr>
<tr>
<td>Product complexity</td>
<td>If the overall production lead time is too long in comparison to customer requirements, the relative lead time of each process step can be analyzed in order to decide where in-process inventories are required to reduce the production time.</td>
</tr>
<tr>
<td>Number of planning points</td>
<td>The decoupling point can only be positioned in between clearly distinct production process entities, which restricts for instance the possibility to separate various steps in an automated, uninterrupted production line.</td>
</tr>
<tr>
<td>Flexibility and setup times</td>
<td>A MTO-setup can only be implemented, if the incurred lead time is satisfactory to the customer (which e.g. requires fast setup times). Resources with sequence depending setup times are usually positioned upstream the value chain, since an order-based sequence might return suboptimal utilization results.</td>
</tr>
</tbody>
</table>

**Table 18: Factors influencing the customer order decoupling point position\(^{318}\)**

Two often related factors are the demand-driven product diversification and the corresponding modular product design as a viable strategy to answer this requirement. Following a similar logic than the order decoupling point, the product differentiation point

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\(^{317}\) Cf. Kummer / Grün / Jammermegg (2006), p. 143. In a linear design, one final product is made out of one raw material (e.g. wire production). In a convergent setup, one final product is made out of several raw materials or pre-products. The term divergent describes a production layout where several final products are made out of one pre-product.

\(^{318}\) Cf. Olhager (2003), p. 320f
indicates, at which point generic pre-products are changed into specific end-products. Since – as shown above - it is easier to forecast the demand for an entire range of final products that rely on a generic production input than forecasting the demand for a specific product it is in the interest of the firm to move the product differentiation point as close to the customer as possible in order to reduce demand uncertainty. This concept was first introduced under the name of postponement by Alderson in the 1950s.

“The principle of postponement requires that changes in form and identity occur at the latest possible point in the marketing flow; and changes in inventory location occur at the latest possible point in time.”  

Bucklin later on specified that the concept of postponement is opposed by the strategy of speculation, where a specified product is forwarded to the end of the value chain. Due to possibly lower production costs based on a planned (and therefore usually to some extent optimized) production schedule, speculation can be a sound strategy in markets with rather constant demand patterns. Looking at distribution chains and having total costs in mind, Bucklin argued that postponement as a strategy is only able to transfer risk, not to avoid it. However, since some parties (e.g. retailers or even consumers) might be able to bear the remaining demand risk at lower cost, there can be overall efficiency gains through postponement.

Nowadays postponement is used in several parts of the production process, including purchasing, manufacturing, logistics and the management of distribution channels (especially with regard to the location of inventory). In each case, benefits are derived from a reduction of uncertainty by a delayed specification of products (cf. Figure 53).

319 Alderson (1957), p. 424
Industry examples for postponement in manufacturing industries include clothing companies (e.g. Benetton postpones dying its clothes to a late point in time of its value chain in order to be able to quickly respond to changing fashion trends),\textsuperscript{323} fast moving consumer goods companies (that postpone labeling their products in order to be flexible with regard to serving several markets that share the same content container but require distinct labels due to different languages)\textsuperscript{324} as well as computer companies (e.g. in contrast to other computer manufacturers Dell does not store finished computers but only assembles standardized components in central assembly plants based on actual customer orders).\textsuperscript{325}

\begin{figure}
\centering
\includegraphics[width=\textwidth]{figure53.png}
\caption{Reduction of demand risk by means of postponement\textsuperscript{322}}
\end{figure}

\textsuperscript{322} Own illustration
\textsuperscript{323} Cf. Yang / Burns (2003), p. 2079 f.; Formerly, Benetton has first colored the yarn and later on knit various garments. However, since it is easier to forecast the demand for different sizes than the required colors (subject to trends) this order has been reversed in order to reduce demand risk and inventories.
4 Flexible time-range tickets as a new measure to increase the overall load factor

In the context of this work, flexible time-range tickets are understood as flight tickets that indicate a time-frame during which a transportation process will take place without specifying the exact flight times and the involved itinerary at the moment of purchase, but only at a certain time prior to the actual departure. The following sections aim at giving an overview of currently used types of flexible products in relevant industries before a discussion of the feasibility of the concept of flexible time-range tickets in the airline industry takes place. During this preliminary evaluation, current studies of passenger demand characteristics will be presented which – together with a qualitative pre-study (cf. chapter 5.1) - set the ground for the generation and examination of empirical research hypotheses in chapter 5.

4.1 Examples for flexible products in the airline industry

In the form of ‘Standby-Tickets’, flexible tickets that do not specify all travel details at the time of purchase have a long tradition in the airline industry. Besides this ticket type, which has lost its significance during the last years, there have only been very few attempts to use flexible products in order to increase the overall demand for an airlines flight program, namely Freedom Air’s Fare Choice offer which has later been continued by Air New Zealand, Lufthansa’s ‘Surprise and Fly’, Condor’s ‘Joker Fliegen’ as well as the Blind Booking Program of the Lufthansa subsidiary Germanwings.

4.1.1 Standby-Tickets

Standby tickets are one-way tickets that give the passenger the right to travel in case that there is ample capacity. If no seats are available in the desired flight, the passenger can either wait for the next available flight or get the ticket costs reimbursed. Due to the fact, that seats for a flight are a perishable resource, standby tickets serve as a viable mean to fill otherwise unused capacity. As long as standby-tickets cover all passenger-related costs they are profitable and allow airlines to exploit the market of spontaneous leisure travelers.326

A special case of standby-tickets where the so-called “Shuttle Services“, operated by several airlines on dense routes along the US-American East Coast (e.g. Washington to New York), which did not require passengers to hold a fixed reservations. Nevertheless, passengers were guaranteed a seat on one of the hourly flights, independent of how many other travelers showed up. This was achieved by a back-up plane that was rolled-out in case the scheduled flight was full. Due to a reduction in (high-yield) demand as well as the high cost of keeping back-up capacity, this service was abandoned by Delta (the last airline operating the shuttle) in 2005.327

Apart of some examples (e.g. AirTran in the USA) there are today hardly any companies that offer standby-tickets to regular passengers (although standby tickets are still used very much for airline employees). This is due to the following reasons:

- Extensive use of standby-tickets resulted in hub airports being overcrowded with passengers waiting for a flight with available seats for several hours, resulting in the fact that airport operators raised concerns about this type of ticket.
- Cost-conscious business travelers purchased a standby-ticket in addition to their fully flexible (and refundable) economy ticket. If there were enough seats they then travelled with their (much cheaper) standby-ticket and afterwards applied for a refund of their unused economy ticket.
- There were cases of standby-passengers that placed additional bookings under a false name over the phone in order to block capacity without a passenger actually showing up, thereby increasing their chance to be carried on their desired flight. This phenomenon has decreased though, since airlines nowadays often require tickets to be instantly paid with credit cards.
- Traditionally, since standby-fares did not guarantee travel within a certain time, they were unattractive to time-sensitive travelers. However, due to the propagation of the internet and the emergence of travel portals that reveal how many seats are still available on a particular flight it is now possible for travelers to pretty well assess their chances of receiving a seat on their desired flight. Since these travelers would normally buy a regular ticket, standby-tickets in this case would result in a cannibalization of revenues. To avoid this effect, airlines would have to restrict standby-tickets to well booked flights, while flights in off-peak times should be filled with Yield Management techniques (i.e. price promotions) instead.

The presented arguments show that although standby-tickets could help to increase the load factor of specific flights, they are not compatible with currently used yield management methods, in which fares rise as the departure date approaches, with the most expensive tickets sold minutes prior to departure (cf. Figure 54).

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328 AirTran, a US-based LCC that operates a fleet of 136 short-haul aircrafts, offers Standby-tickets to young passengers aged 18-22. The tickets do not guarantee a seat on the selected day, however, in case no seat was available, passengers get a full refund (cf. Airtran 2010, www.airtranu.com).

4.1.2 Freedom Air’s Interactive price response tool ‘Fare Choice’

Freedom Air has been founded as a subsidiary of Air New Zealand in 1995 and offered regional low-cost services with a fleet of 12 Airbus A320 aircrafts until 2008, when it was re-integrated into the mother company.

In May 2003 the company has launched a flexible product named ‘Fare Choice’ that allowed customers to select their origin and destination cities, the length of stay, their earliest possible departure date, their latest possible return date as well as the desired prior notice period, i.e. the time prior to departure at which they want to be informed of the actual flight assignment (cf. Figure 55). In the course of the integration of Freedom Air into Air New Zealand the ‘Fare Choice’ product has been altered to Air New Zealand’s Mystery Breaks (cf. the following section).

330 Cf. Stiftung Warentest (2009), p. 74ff; Similar results were also obtained during an analysis of 879 LCC flights in 2008. The average ticket fare of the analyzed LCC (Ryanair, Easyjet, Air Berlin, Tuifly, Germanwings) 60 days prior to departure was only one third of the last quoted fare. The most extreme price changes were observed at Ryanair flights. Customers that booked on the day of departure paid in average 10 times the price of customers who booked 60 days in advance (cf. Gerres (2009), www.flugkurve.de).
During the availability of the Fare Choice booking screen, website visitors were able to build their own customized price by combining various parameters of the booking interface, based on an interactive price-response (IPR) system that has been developed by the IT-company SigmaZen.

The offered price depends on a configured minimum price, to which a certain premium is added based on a calculated discount factor ($\delta$).

$$\text{Price offered} = \text{minimum price} + \delta \times (\text{configured maximum price} - \text{minimum price})$$

The discount factor itself depends on the entered search parameters, the cheapest available fare during the intended travel period as well as on a set of weighting parameters ($\alpha$, $\beta$) that can be configured by the airline in order to determine the slope of the discount factor as a function of the shown flexibility.

$$\delta = (1 - \frac{A}{A_{\text{max}}})^\alpha \times \left(\frac{PN}{PN_{\text{max}}}\right)^\beta$$

with: $\alpha$ = entered configuration parameter ($\alpha < 0$)  
$\beta$ = entered configuration parameter ($\beta < 0$)  
$A$ = amount of remaining, unsold seats on all flights during the selected time window  
$A_{\text{max}}$ = total capacity (sold and unsold) on all flights during the selected time window  
$PN$ = selected prior notice period  
$PN_{\text{max}}$ = highest PN that could possibly be entered during the booking process

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331 Cf. Mang / Spann / Post (2008), p. 196
332 As a side effect the customization of offered tariffs also allows airlines to sell seats at a discount without having to publish its discount level to competing airlines that use price-seeking bots in order to systematically screen the online market for airline tickets (cf. Garrow (2009), p. 252).
333 Cf. Lee / Garrow / Post (2009), p. 5f
Overall the discount factor $\delta$ becomes larger, the more a customer is willing to accept uncertainty (by selecting a shorter prior notice period) and the more the airline (based on its forecasts) assumes that there is ample capacity on the flights in the selected time window (cf. Figure 56).

To avoid a cannibalization of revenues from high-yield passengers, the availability Freedom Air's Fare Choice product was restricted to travels lasting between 3-21 days, with the earliest departure date being at least three weeks ahead of the booking date. Furthermore by requiring travelers to select a travel window that is at least twice as large as the desired length of stay, the system forced travelers to exhibit a certain minimum degree of flexibility in order to profit from cheaper fares.

During the period from August 2004 to June 2006 the system has been used by 12,588 individual customers that have conducted 42,963 searches which led to 474 purchases (which, given that some unique visitors have done several searches, corresponds to a conversion rate based on visitors of 3.3%). Compared to the overall traffic volume of Freedom Air's website (approximately 170,000 visitors per month) during the same period, these figures show that only about 1% of the visitors were interested in the

Figure 56: The relation between remaining capacity, uncertainty and applicable discount\textsuperscript{334}

\textsuperscript{334} Cf. Lee / Garrow / Post (2009), p. 8 as well as Mang / Spann / Post (2008), p. 197
offered flexible product, with conversion rates too staying below the average values reported by other airlines (9-14%).\textsuperscript{335}

An analysis of the online click-stream data of the Freedom Air website has shown that the propensity to actually purchase a ticket was strongly correlated with the offered discount. Although changes in the pricing policy by the airline during the examination period impaired the comparability of various observations, it became obvious that as a result of the strong imposed tariff restrictions passengers also expected a significant discount in comparison to the lowest regularly available fare in the requested travel period. Only if consumers were confronted with a discount rate of 40% or more the purchase propensity was found to be larger than 1% (cf. Figure 57).

![Figure 57: Purchase propensities as a function of the offered discount factor\textsuperscript{336}](image)

Once a customer booking was accepted by the Interactive Price Response System (IPRS), this event did not immediately trigger a booking process at the traditional airline booking system, but resulted in an interim storage of the request at a database of the IPRS. To ensure that the airline is able to accommodate the flexible booking, the IPRS regularly checks the remaining capacity on the flights during the time window of the customer. If capacity becomes too scarce or the notice period of the customer starts, the IPRS then places a booking on the flight with the largest amount of free seats at the main booking system by means of an Application Programming Interface request and informs the customer of the assigned flights accordingly (cf. Figure 58).

\textsuperscript{335} Cf. Lee / Garrow / Post (2009), p. 6 (overall traffic volume) and 12 (search & purchase data); cf. Nielsen/Netratings (2005), p. 1. The best conversion rate has been observed at the LCC Southwest, where 14% of all customer visits have resulted in bookings.

\textsuperscript{336} Cf. Lee / Garrow / Post (2009), p. 16f. The unexpectedly high level of conversions at the 10% discount level has been explained by the authors by the fact that the airline initially has strongly limited the amount of offered discount which resulted in many customers (even after extensive searches for higher discounts) only finding and finally also purchasing tickets at a 10% discount level.
Overall the airline targeted leisure travelers as well as business travelers that are either self-employed or work for a small enterprise with the Fare Choice system. As, Darren McLean, revenue manager at Freedom Air, stated, "business travelers often cannot trade away their flexibility for price. These customers are traditionally more happy to pay a premium for certainty." A survey among customers of the new ticket type came to the conclusion that 95% of all passengers were (very) satisfied, and that most additional revenues resulted from additional bookings (i.e. that little cannibalization took place).

4.1.3 Tickets without specified destination at Air New Zealand, Lufthansa, Condor and Germanwings

4.1.3.1 Air New Zealand Mystery breaks

After the integration of its subsidiary Freedom Air the company Air New Zealand has ended the Fare Choice booking option and launched its own flexible product under the brand name "Air New Zealand Mystery breaks" (cf. Figure 59 which shows a screenshot of the booking screen). When booking a mystery break, customers receive a voucher that is valid for a domestic flight as well as two nights in a hotel at their destination (incl. transfer), which they can redeem within six months after the purchase. Upon redemption

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337 Own illustration, based on Mang / Spann / Post (2008), p. 198f
338 Seligman (2003), findarticles.com
of the voucher, the passenger names have to be specified and a travel date within 1-8 weeks after the reservation has to be selected. As the airline makes the applicability of the voucher subject to the availability of free seats, it can be the case that the desired travel period is not accepted. While the price of the entire travel package is fixed (starting at approximately € 295 per person), the customer is only informed of the required check-in time (on the selected date) two days prior to departure. It is only at check-in that the final destination is revealed.340

![Figure 59: Air New Zealand's Mystery Breaks enquiry form](image)

While Air New Zealand is apparently the only airline in the Pacific region that currently offers this kind of product, there have been similar products in place already twenty years earlier. Ansett Australia, an airline of which Air New Zealand has in 1996 acquired a share of 50%, has introduced its first Mystery fare in December 1989. For 50 Australian Dollars (which at the time was equivalent to approximately 33 Euro), customers were able to purchase a domestic same-day return trip. The destination was only revealed at check-in. However, due to its weak financial standing, Ansett Australia was forced to declare bankruptcy in the days after September 11, 2001, which has also put an end to its Mystery Fare program.342

4.1.3.2 Lufthansa’s ‘Surprise and Fly program’

In 1998, Lufthansa has launched in cooperation with the internet service provider AOL a promotional product that was named ‘Surprise and Fly’, which has exclusively been offered to AOL customers via the internet. For DM 249 (€125) per person, passengers were able to book a ticket at a specified date within 5-30 days after the purchase date to
one out of 17 European destinations. Only five days prior to departure, the passengers were then informed about the actual destination via email. By restricting the offer to outgoing flights on Friday or Saturday and return flights on Sunday or Monday, the airline made clear that the offer was targeted at leisure travelers that want to spend a weekend at a European metropolis.\textsuperscript{343}

In 1999, the offer has been extended to intercontinental flights for a price of DM 999 (€500) for two persons. Similar to the European offer, passengers were able to decide about the travel time as well as the desired continent (North America or Asia) and were then assigned to a specific flight five days prior to departure.\textsuperscript{344}

A few months after the introduction, the airline stated that approximately 30-60 bookings (with a strong upward trend) per week were received through its ‘Surprise and Fly’ booking tool.\textsuperscript{345} While this at first seems a very low response to the offer, one has to keep in mind that in 1998, only 10% of the population had access to the internet at their homes, a group out of which approximately 20% had an AOL subscription, which was necessary to purchase a ‘Surprise and Fly’ ticket. Furthermore, a survey among internet users also revealed that at the time only 13% used the internet as a shopping channel.\textsuperscript{346}

Although the airline does not offer ‘Surprise and Fly’ anymore, Lufthansa has in 2009 introduced a ‘trip finder’ feature on its website, which again addresses a price-sensitive traveler group by allowing users to search for cheap flights without having to specify a destination or precise travel dates. Travelers can enter their maximum budget as well as a suitable time-range for their travel and are then offered suitable flights and destinations by the airline (cf. Figure 60).

\textsuperscript{343} Cf. AOL TimeWarner (1998), www.timewarner.com
\textsuperscript{344} Cf. Krohn (1999), www.zeit.de
\textsuperscript{345} Cf. Schambach (2010), www.schambach.de
\textsuperscript{346} Cf. ARD / ZDF (1998), p. 1ff
According to Marcus Casey, Lufthansa’s head of e-commerce, the tool has been successfully launched in Germany, the UK and USA and will soon be rolled out in other important markets too.\textsuperscript{348}

### 4.1.3.3 “Blind Booking” at Germanwings

Germanwings is a Cologne-based Low-Cost Airline that is to 100\% owned by Lufthansa. As at March 2010, the airline operates 30 aircrafts and serves 75 destinations in Europe. In November 2007, the carrier added a new booking option that it called “Blind Booking” to its website, which offers a flexible product to adventure-seeking customers. For a price of € 19.99 (including all applicable taxes and charges) passengers can select a flight date and their departure airport as well as a destination-theme. Available themes are ‘Sun & Beach’, ‘Party’, ‘Culture’, ‘Metropolis Western Europe’, ‘Metropolis Eastern Europe’ and ‘Shopping’. By selecting one of the available themes, a customer can be sure, that he or she will get a flight on the desired day to one out of several destinations that were grouped under a theme. The actual destination though is only revealed after the completion of the booking process. To limit the number of potential destinations (under one theme at least nine and up to 17 destinations are grouped) travelers can pay

\textsuperscript{347} Cf. Lufthansa (2010b), www.lufthansa.com
\textsuperscript{348} Cf. Sobie (2010b), www.flightglobal.com
a surcharge of €2.50 per direction and destination to exclude certain cities, until they no more than three choices are left.\textsuperscript{349}

According to Germanwings the Blind Booking tool is subject to a growing acceptance (at a satisfactory level) and serves as a mean to reach new target groups. During the summer of the year 2009, the company has in average sold approximately 450 seats per day by means of Blind Booking.\textsuperscript{351} Based on the booking data the company observed that the product primarily appeals to young travelers (especially couples) that are aged between 16 and 30 years. The majority of customers do not exclude any destinations out of the available set, while approximately one quarter of all passengers have at least excluded one destination before sending their binding booking request. By limiting the offer to flights that depart within the next 45 days the company is able to incorporate already relatively good passenger forecasts in its decisions regarding which (low-demand) flights can be sold via the blind booking tool. For this reason the tool is seen as a viable mean to fill demand gaps by inducing additional demand.\textsuperscript{352}

\textsuperscript{349} Cf. Germanwings (2010), http://www.germanwings.com
\textsuperscript{350} Cf. Germanwings (2010), http://www.germanwings.com
\textsuperscript{351} Cf. Rodrian (2010), http://www.abendblatt.de
\textsuperscript{352} Cf. Interview Entcheva (2009)
On the technical side ‘Blind booking’ was realized as an additional booking interface by the IT companies 2e and Sigmazen (the same company that also installed Freedom Air’s Fare Choice module). The system automatically retrieved the availability of flights and placed final bookings using the Navitaire NewSkies booking systems Application Programming Interface (API).353

4.1.3.4 Condor’s ‘Joker Fliegen’
In March 2010, the German charter Airline Condor added the feature “Joker Fliegen” to its website. Similar to Germanwings’ Blind Booking concept, customers can select their flight dates (the system always requires the purchase of a return flight) as well as a travel theme, which comprises either short-haul or long-haul destinations. In case a customer wants to avoid a certain destination, he or she can exclude up to eight destinations by paying a small surcharge (e.g. €19 for each excluded long-haul destination). Directly after the booking is completed, customers are then informed about the actual flights that they will take. To compensate the customer for the incurred uncertainty, the flights are heavily discounted (e.g. a ticket for the theme ‘long-haul flights’ which comprises destinations such as the Seychelles, Phuket or Las Vegas is sold at €298, which is roughly 50% cheaper than regular fares to these destination). The facts that on the one hand the travel date is not allowed to be more than two months ahead of the booking date and that on the other hand the ticket is subject to availability (i.e. is not available on all possible departure dates), indicate that the airline primarily uses the tool as a mean to sell otherwise unused capacity.354

4.2 Examples for flexible products in the tourism industry
While being relatively new in the airline industry, flexible products have already been used in the entertainment business355 as well as in the tourism industry for a longer period. One can distinguish between flexible products where the customer is assigned to a specific option instantly after completion of the booking, as well as products where the customer is only assigned shortly prior to the consumption of the purchased service.

4.2.1 Assignment of the customer to a specific product after completion of the booking
During the last decade, the internet gave rise to several online booking platforms, who serve as intermediaries between customers and hotels. Next to traditional online travel agencies (e.g. Expedia or Opodo), companies such as Priceline, Hotwire and Travelocity managed to rapidly gain market shares by also offering flexible products on

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354 Condor (2010), https://jokerfliegen.condor.com
355 Other leisure activities which use flexible tickets are theatres. The Thalia theatre in Hamburg for instance allows customers to buy a subscription for several audiences on a particular day of the week, without knowing which performances they will actually see. After the program is published, customers can then exchange unwanted shows against others by paying a fee (cf. Thalia (2009), http://www.thalia-theater.de).
their sites (also called 'opaque' products). Already in 2006, the three mentioned websites accounted for 13.5% of all hotel nights booked globally.

What these providers have in common, is the offer of products, where price, dates and location are fixed while the name of the hotel that a customer wants to book is “hidden” to the customer until the booking is completed. In order to be compensated for this uncertainty, customers profit from a discount of up to 55%. While Hotwire and Travelocity offer the customer a fixed price for the ‘unknown’ hotel, Priceline goes a step further and allows customers to name their desired price (cf. Figure 62). In the latter case, customers have to wait approximately 20 minutes before they learn, whether their bid was successful or not. Thereby Priceline makes it less attractive to place only marginally incremented bids starting at an unreasonably low amount in order to find out the reservation price of the hotels in the relevant set.

![Figure 62: Websites of flexible product vendors in the hotel business](image)

Having established their services in the hotel industry, Hotwire and Priceline have at a later stage also started offering flexible tickets for airline flights. This idea has also been adopted by other platforms such as the UK branch of lastminute.com, which has started

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356 Schaal (2010), www.tnooz.com;  
357 Cf. Shapiro / Shi (2008), p. 807ff. Although all three sites also offer fully specified hotel bookings, for instance Priceline in 2006 stated that flexible products formed the ‘substantial majority’ of their bookings.  
358 Travelocity (2010), www.travelocity.com  
to sell “top secret flights”, where the customer is only informed about departure and arrival city, the flight duration, the travel dates and whether the flight is direct or indirect at the moment of purchase. According to the platform, the uncertainty regarding the operating airline, the actual departure and arrival airports (in case there are several airports serving a destination) and the actual flight times is reimbursed with a discount of up to 22% in comparison to fully specified tickets.\footnote{Cf. Last Minute Network Limited (2010), lastminute.com; Since most flights that are offered depart from London, hiding the actual departure airport prior to purchase, leaves it open from which out of the five airports around London (Heathrow, Gatwick, City, Stansted & Luton) the flight will leave, thereby resulting in significantly more uncertainty than this would be the case in cities with only one airport (e.g. Vienna).}

Even more flexibility is required when a flight is booked via Priceline’s Name Your Own Price tool, since the airline does not even specify, whether the flight is non-stop or involves a connection:

“Your trip will start between 6am and 10pm on your travel dates. Although we always look for non-stop flights first, Priceline flights may make up to one connection each way. Your exact flights and times will be shown to you once your purchase is complete.” \footnote{Cf. Priceline (2010b), www.priceline.com; At a later stage of the booking process, the conditions are explained in more detail, stating that layovers will not be longer than three hours and that the passenger is guaranteed to arrive at the latest at 12:30 a.m. of the following day. Furthermore, as it is also the case with flexible tickets booked on other platforms, the ticket cannot be amended and does not allow collecting frequent flier miles.}

All presented platforms resell distressed inventory from airlines, without designating the actual carrier. By means of hiding some flight details, the product is clearly targeted towards a very price-sensitive target group. Thereby it is ensured that the operating airline does not cannibalize its own sales channels, where it can still simultaneously offer the same seats for a higher price. While it is generally accepted that flexible products can potentially expand the addressable market of airlines by targeting new customers, airline managers have also raised concerns that selling inventory through these channels, in the long run decreases the perceived importance for flight characteristics other than the price and therefore lead to an overall price decline. Based on market models, though, Shapiro and Shi state that opaque tickets can even lead to an increase in revenues since they allow airlines to maintain or even increase their prices of non-opaque, i.e. regular, products.\footnote{Cf. Shapiro / Shi (2008), p. 807ff}

4.2.2 Assignment of customers to a specific hotel after the arrival at the destination – the case of “Glückshotels”

The German provider Neckermann (part of the Thomas Cook plc) offers flexible products under the brand name “Glückshotels” or “Roulette Hotel”. Customers can decide for a date, a holiday destination and a hotel category at the moment of booking their trip. After the arrival at the destination airport, they are then informed about the actual hotel where they will be accommodated (cf. Figure 63).
By delaying the assignment of customers to a specific hotel until the passengers’ arrival at the destination, the tour operator can fill up empty rooms based on revealed demand (including cancellations upon short notice). Thereby, in contrast to the products presented in chapter 4.2.1 that instantly after the purchase publish the assigned alternative, the offer of ‘roulette hotels’ does not only serve as a price differentiation tool but also allows the operator to manage demand deviations more efficiently, which leads to an improved utilization of the overall capacity.364

4.3 The characteristics of air travel demand

The previous chapter has shown several current applications of flexible products, which can serve as a starting point in the development of the proposed flexible time-range ticket design. Before this is done, the following chapter gives an overview of the structure of air travel demand as well as the value that different customer segments attribute to certain flight characteristics.

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363 Cf. Neckermann (2010), www.neckermann.de. Flexible products are also offered by many other operators. Neckermann’s largest competitor TUI, for instance, sells a similar product called “Sparreise”.  
364 Cf. Petrick et al. (2010), p. 2034f
4.3.1 Structure and characteristics of passenger air travel demand

Given the strong diversity of customer needs within consumer markets, it is usually not economically meaningful for a company to aim at covering the entire market with its product range. Therefore in developed markets a company’s marketing strategy usually includes decisions regarding which customer groups should be targeted (segmentation and targeting) and how these groups should be served (differentiation and positioning).

In the process of segmentation, companies analyze the market in order to identify (relatively) homogenous customer subgroups with similar product requirements that allow for a specific marketing approach in order to address them. An effective segmentation requires the segments to be measurable (i.e. based on market research data a company should at least be able to estimate the size as well as the characteristics of a particular segment), accessible by means of communication measures, substantial (i.e. large enough to outweigh the costs of a differentiated approach towards this segment), differentiable (i.e. the identified segments should dispose of different product requirements and / or preferred communication channels) as well as actionable (i.e. the company has the required resources to address an identified segment).

To distinguish segments, one can on the one hand use demographic, geographic or, psychographic criteria (with the latter usually requiring a combination of the former in order to be able to practically address the segment) or, on the other hand, rely on documented usage or purchase criteria in order to identify segments with differing criteria. 365 In the airline sector, traditionally the main segmentation variable has been the journey purpose, which with regard to Yield Management practices has been deducted based on the selected flight dates as well as flexibility and service requirements. However, since airlines nowadays are able to evaluate more personal customer data (on the one hand due to the rising amount of internet bookings where more data can be collected than with other sales channel and on the other hand due to the growing importance of frequent flyer programs), this allows them also to integrate more person-specific customer characteristics in their segmentation practices (cf. Table 19 for an overview of possible segmentation criteria in the airline passenger market).

<table>
<thead>
<tr>
<th>Category</th>
<th>Main types / differentiation criteria</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Journey purpose</td>
<td>Business</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Corporate travelers</td>
<td>Usually do not pay their flights themselves</td>
</tr>
<tr>
<td></td>
<td>Independent business travelers</td>
<td>These travelers comprise self-employed or small companies employees who require similar service characteristics than corporate travelers but have tighter budget constraints.</td>
</tr>
<tr>
<td></td>
<td>Holiday</td>
<td>Holiday travelers usually require additional expenses such as hotel or transfer.</td>
</tr>
<tr>
<td></td>
<td>Visiting friends and relatives (VFR)</td>
<td>Travelers have no additional expenses at their destination, therefore even people with low income can afford flights.</td>
</tr>
<tr>
<td></td>
<td>Pilgrimage, medical treatment trips, etc.</td>
<td>The mentioned traveler groups are often not flexible with regard to dates and less price sensitive than other leisure travelers.</td>
</tr>
<tr>
<td>Flight and service characteristics</td>
<td>Frequency, schedule of flights and punctuality</td>
<td>Time-sensitive travelers value several possible flight alternatives as well as an on-time arrival. This for instance allows business travelers to fly in for a meeting shortly before it begins and leave soon after it has ended.</td>
</tr>
<tr>
<td></td>
<td>Seat accessibility and ticket flexibility</td>
<td>For some travelers, it has a distinct value to be able to rebook a ticket shortly before the planned travel (which requires the airline to manage capacity in a way that some free seats on alternative flights are preserved).</td>
</tr>
<tr>
<td></td>
<td>Frequent flyer benefits</td>
<td>For some passengers the opportunity to earn miles on a flight (or to profit from dedicated FFP benefits) can outweigh a price difference.</td>
</tr>
<tr>
<td></td>
<td>In-flight &amp; airport service</td>
<td>Although the role of in-flight service has decreased during the last years, there are still many travelers that consider this criterion in their purchase decisions (especially on long-haul flights). Airport service (e.g. airline lounges), is important if customers have to cover long transfer times at an airport.</td>
</tr>
<tr>
<td></td>
<td>Length of journey</td>
<td>Travelers usually exhibit different service expectations for short or long haul flights.</td>
</tr>
</tbody>
</table>

Table 19: Traditional air passenger demand segmentation criteria

Several studies have dealt with passenger segment characteristics. Doganis, for instance, presents the preference structure of four key segments (‘holidaymaker two weeks’, ‘weekend trip’, ‘routine business trip’, ‘emergency business trip’) with regard to a few characteristics that basically confirms the main trends outlined in Table 19. What

stands out, however, is the fact that holidaymakers that were asked to rate the importance of various features (incl. price, seat availability, frequency, in-flight amenities, etc.) on a scale from 1 (not essential) to 5 (very essential) in average described the price to be very essential and did not consider any of the remaining features to be more important than two. On the other side, business travelers considered frequency as very essential, with the price only playing a minor role. This finding was also confirmed in a different study, during which business travelers were asked to rank product features according to their importance. While the convenience of the schedule was ranked first, the price was only ranked on the eighth out of 12 positions.

Meffert and Bruhn present the results of a segmentation study among airline travelers who were flying on private purposes that allocated 75% of all travelers into a price-oriented segment, while 15% mainly focused on service quality (i.e. seat pitch, catering and in-flight entertainment) and the remaining 10% valued flexibility (i.e. good onwards connections and high flight frequency) the highest.

The predominance of the price among leisure travelers is equally apparent when travelers that travel with low-cost airlines are questioned. Based on a recent survey among almost 788 passengers of the LCC Ryanair at Frankfurt-Hahn Airport, Schröder found the ticket fare price to be the most important factor in the tourist’s decision making process. 65% of respondents rated this criterion as very important, followed by the destination (63%), the time gain by using the airplane (55%) and the total costs of travel (47%). The definite flight time was only rated as very important by 42% of respondents, with 8% even choosing the opposite side of the scale (“did not matter”). In line with these results, a study among passengers at Barcelona’s Girona airport (which is again, predominantly used by LCC) found that 88.5% of all passengers considered the price as the (by far) most important decision criterion for their flight. However, the differing valuation of other characteristics allowed the authors to further distinguish three segments within this group. The largest segment (45.5%), though, were again price-sensitive travelers who, when asked to rate the importance of product attributes on a five-point scale, rated the price in average with 4.86, with the second and third most important attributes related to the flight (valuation of closeness of the airport to destination and valuation of flight duration) being rated only at 2.69 and 2.33 respectively.

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368 Cf. Doganis (2002), p. 239
371 Cf. Martinez-Garcia / Royo-Vela (2010), p. 235. Within the “price-sensitive” segment young people (especially students) as well as well educated people were overrepresented in comparison to the sample average. The second largest group (“Destination and flight conscious travelers”) differed in so far, as these passengers valued travel duration higher (3.90).
Newer articles, however, argue that the currently used segmentation criteria (especially flight class and journey purpose) are no longer appropriate. To discover new segments Teichert et al. have conducted a Choice-Based conjoint analysis among a sample of 5,800 frequent flyers. The results indicate that there five distinguishable customer segments (cf. Table 20):

<table>
<thead>
<tr>
<th>Segment</th>
<th>Important features</th>
<th>Predominant characteristics (above sample average)</th>
</tr>
</thead>
</table>
| 1 – Efficiency, Punctuality (19%) | Punctuality, flexibility and frequent flights (schedule) | • Several flights per week  
• Male  
• Decision-making & booking outsourced  
• University degrees  
• Leadership positions |
| 2 – Comfort (19%)  | Catering, flexibility                                  | • Several flights per month  
• Elderly customers  
• Male  
• Prefer personal care in the booking process |
| 3 – Price (9%)     | Price                                                   | • 2-4 flights per year  
• No leadership responsibilities |
| 4 – Price / Performance (33%) | Price & punctuality                                   | • Entrepreneurs  
• Lower / middle Management  
• Booking made by corporate travel agent |
| 5 – Catch All / Flexibility (20%) | Balanced across all features                          | • Several flights per month  
• Avoid face-to-face bookings |

Table 20: Alternative airline customer segmentation

Although Teichert et al. are right in differentiating the traditional segmentation across business and leisure travelers into more segments based on their relative valuation of the price in comparison to other features such as flexibility, comfort or punctuality, their proposed segmentation does not reveal unexpected results. As a main point, one can take out though that entrepreneurs or employees of smaller companies nowadays act more like price-conscious leisure travelers than classical business travelers.

4.3.2 The choice of a particular flight

The previous chapter has shown the results of segmentation studies, which cluster consumers based on their revealed or stated preferences with regard to certain attributes. In the following, the consumer choice decision with regard to several flights will be analyzed in more detail. In order to better understand the influence of flight characteristics such as schedule attractiveness, itinerary (non-stop or indirect) and flight duration, which would be strongly touched by flexible time-range tickets, several studies focusing on these aspects will be presented and discussed.

372 Cf. Teichert (2008), p. 227ff
4.3.2.1 Individual choice model models in airline revenue management

Predicting consumer choices with regard to transportation alternatives has always been of huge interest to (public) transport planners and other industry participants. A major advancement in this field has been the introduction of discrete choice models in order to forecast travel mode choices (of inhabitants of the San Francisco Bay Area) by Daniel McFadden in 1974. Other scholars who were building upon classical rational choice utility models in order to forecast transport mode decisions were Ben-Akiva and Lerman in 1985. In 1987 Peter Belobaba adopted these thoughts and translated them into airline revenue management environment. Since from the passenger perspective, flying from A to B is in most cases not an end in itself but rather a mean to move to a desired location, the demand for flights can in the vast majority of cases be understood as derived demand. As a consequence, the “travel itself imposes costs or disutilities which must be incurred to realize the benefits of the trip.”

When confronted with several flight options, an individual is going to evaluate the available alternatives based on his or her preferences and the nature of the trip. In this process, the decision maker is going to value the disutilities attached to various characteristics of a flight, such as the departure time or the ticket price.

“The price of a travel option is therefore not simply the monetary cost of the ticket. Various travel options can involve additional disutilities and monetary costs associated with the timing of the travel components of the trip, as well as the value of the time actually spent travelling.”

Since the benefit of a trip is (aside from the arrival time) independent from the disutility of the available flight alternatives, the question, whether or not a person is going to travel is decided by comparing the benefit of the trip with the costs of the available transport alternatives. The choice set for an individual consumer is composed of all alternatives, which do not create larger disutility than the achievable benefit at the destination. Within this choice set, the customer is going to evaluate the distinctive product attributes of the offered alternatives in order to select the flight with the lowest incurred utility. Since it is usually not possible to examine all possible alternatives, the consumer is in most cases not able to make the optimal choice, but is going to select the “alternative providing the lowest perceived disutility from among those considered, given feasibility and availability of that alternative.”

In the analysis of consumer choice decisions, one has to keep in mind though that it is usually not possible (or feasible) to incorporate all decision-variables of a consumer in a model. Therefore, the ‘random’ utility concept accepts a certain deviation from the

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375 Belobaba (1987), p. 43
376 Belobaba (1987), p. 51 (original accentuation by P. Belobaba)
expected behavior, which does not imply an irrational behavior but rather demonstrates the lack of the researcher to include all decision variables. As a result this approach clarifies that that expected behavior can only be predicted with a certain probability.378

4.3.2.2 The value of travel time and travel reliability

Since different travel itineraries and modes usually imply different trip duration, passengers also have to include the expected travel time in their decision process. However, since the actual trip duration in most cases differs from the scheduled or expected duration, passengers usually also have to incorporate the expected reliability of published trip durations. Unreliable services can either lead to the inclusion of buffer time, which in return results in a higher overall expected trip duration, or can force the customer to select an earlier alternative in case an on-time arrival is essential.

Research on the value of travel time has a long tradition.379 Besides its role in forecasting customer choice, the value of travel time savings (VTTS) is also highly relevant in determining the benefit of infrastructure improvements in the course of a cost-benefit analysis. With regard to planned infrastructure development projects, assessing the VTTS is usually based on Stated Preference surveys, since the absence of the planned route does not allow for an analysis of Revealed Preference data. In a recent Swiss study for instance, survey respondents were asked to select their preferred trip in a conjoint analysis setting including car and rail offers. Based on the exhibited preference structure, the researchers were then able to monetarily assess VTTS (cf. Table 21).

<table>
<thead>
<tr>
<th>Trip purpose:</th>
<th>Business</th>
<th>Commuters</th>
<th>Leisure</th>
<th>Shopping</th>
</tr>
</thead>
<tbody>
<tr>
<td>VTTS for public transport (€ per hour)</td>
<td>mean € 16.01</td>
<td>€ 12.04</td>
<td>€ 7.57</td>
<td>€ 8.33</td>
</tr>
<tr>
<td></td>
<td>Var. € 1.12</td>
<td>€ 0.25</td>
<td>€ 0.11</td>
<td>€ 0.33</td>
</tr>
<tr>
<td></td>
<td>Std.dev. € 1.06</td>
<td>€ 0.50</td>
<td>€ 0.33</td>
<td>€ 0.58</td>
</tr>
<tr>
<td>VTTS for car travel (€ per hour)</td>
<td>mean € 17.59</td>
<td>€ 12.11</td>
<td>€ 11.97</td>
<td>€ 11.34</td>
</tr>
<tr>
<td></td>
<td>Var. € 6.98</td>
<td>€ 0.33</td>
<td>€ 1.33</td>
<td>€ 0.89</td>
</tr>
<tr>
<td></td>
<td>Std.dev. € 2.64</td>
<td>€ 0.58</td>
<td>€ 1.15</td>
<td>€ 0.94</td>
</tr>
</tbody>
</table>

Table 21: Value of travel time savings according to the trip purpose380

The results show substantial differences in the willingness-to-pay for travel time savings according to the purpose of the trip, with business trips showing a VTTS which is more than twice as high as the VTTS in the case of leisure trips. This is in line with the finding

379 De Vany, for instance, has already in 1974 published a paper on “The Revealed Value of Time in Air Travel” based on data from 1969. At the time, the price of one hour was found to be $7.28 – which would correspond to approximately $43 in current terms. This rather high value also reflects the fact that flying at the time was almost exclusively limited to people with a high income (cf. De Vany (1974), p. 81).
380 Cf. Axhausen et al. (2008), p. 184. The original values have been converted from Swiss Francs to Euro using the average exchange rate from 2006, which is the year of the underlying field work (0.6358, cf. Oanda (2010), www.oanda.com).
that the willingness-to-pay is higher in case of larger incomes, since these respondents value their own time higher than respondents with a low income. Furthermore, the VTTS was found to increase with longer travel distances. Respondents with a yearly income of €130,000 (category mean) were assessing the VTTS on longer car trips (>250km) on business purpose with approximately €70 per hour, which is 4.4 times higher than the average of all business trips.381

As already observable in Table 21 the VTTS does not only differ between different travel purposes but also between different modes of transport. On the one hand, this is driven by the fact, that certain modes of transport (e.g. air travel) are not equally used by all income groups; on the other hand this is also influenced by the different characteristics inherent to various modes of transport. While passengers travelling by car for instance place a high value on flexibility, passengers using the airplane usually consider the achievable time savings as critical in their transport mode decision (on short haul routes). As a result, air travel VTTS are significantly higher than those of other modes of transport. This is also confirmed in a meta-analysis of 90 different VTTS studies. In order to normalize the values from different countries, the authors expressed the VTTS as a percentage of the average hourly wage rate. On average, an hour of air travel time is valued 76% higher than the average VTTS of all analyzed studies (cf. Table 22).

| Differences in the valuation of time across modes of transport |
|---------------------------------|-----------------|----------------|
| Mode of transport              | Number of studies | Average VTTS (% of wage rate) | Standard deviation |
| Airplane                        | 4               | 146                      | 82                   |
| Bus                             | 8               | 57                       | 49                   |
| Car                             | 70              | 82                       | 69                   |
| Train                           | 8               | 77                       | 44                   |
| Total                           | 90              | 83                       | 67                   |

Table 22: Differences in the valuation of time across modes of transport382

While there are many studies on the value of time regarding car travel, empirical data covering other modes of transport are rare. Two of the most recent studies that also feature air transportation include the Norwegian value of time study from 1997 as well as a Europe-wide analysis from 2002. The actual values of time from these studies are depicted in Table 23.

381 Cf. Axhausen et al. (2008), p. 182
Valuation of the time spent for air travel

<table>
<thead>
<tr>
<th>Study</th>
<th>Business travel</th>
<th>Leisure travel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Norwegian Value of Time Study (1997)</td>
<td>€ 44.20</td>
<td>€ 20.41</td>
</tr>
<tr>
<td>Austrian VTTS estimates for air travel, HEATCO project (2002)</td>
<td>€ 39.11</td>
<td>€ 12.91</td>
</tr>
<tr>
<td>US study (2004)</td>
<td>€ 55.52</td>
<td>€ 15.81</td>
</tr>
</tbody>
</table>

Table 23: Valuation of the time spent for air travel

In their travel decisions, consumers also have to take into consideration that there might be a difference between the scheduled (or expected) and the actual travel times. This affects the disutility of travelling in two ways.

First of all, arriving earlier than expected results in excess time at the destination, which in many cases cannot be used in a pleasant or productive way. Even worse, arriving too late at the destination may lead to more severe consequences if other scheduled events (e.g. a connecting flight or a scheduled meeting) have already started. In an experimental Stated Preference survey among British car drivers, Bates et al. found that the respondents were willing to pay up to € 1.82 in order to decrease the average deviation between expected and actual arrival times by one minute (in case of late arrivals).

Besides the decrease in utility resulting from the loss of usable time, research also indicates that uncertainty as such is unattractive to travelers.

“Travelers place some sort of value on [...] on the uncertainty induced by variability per se [...] This may be result of the anxiety or stress caused by uncertainty, or additional cognitive burden associated with planning services, including, in the case of scheduled services, pure irritation associated with failure to run services as advertised.”

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383 Cf. Ramjerdi et al. (1997), p. 54 and p. 88. For business and leisure trips the values for in-vehicle time for trips beyond 50km were used. With regard to business trips the data from wave 1+2 was considered. The Norwegian values were converted to Euro using the average exchange rate between Norwegian Krone and the ECU in 1997 (0.1252, cf. Oanda (2010), www.oanda.com).

384 Cf. HEATCO (2002), p. S9f. For private trips the value for „Other – Long Distance“ was selected.


387 Cf. Lia / Hensher / Rosea (2010), p. 385; In their meta-analysis the authors present various examples where the Value of Reliability (measured as average lateness, with early-arrivals being counted as ‘on-time’ arrivals) is even higher than the VTTS, which implicates that the uncertainty of being (in average) one hour late is valued more severe than actually travelling one hour more.

388 Cf. Bates et al. (2001), p. 194
In customer choice models this is absolute disutility level is often modeled by means of a binary variable that indicates whether the arrival is expected to be on schedule or not.

4.3.2.3 The importance of a fit between desired and offered departure time

When searching for a flight, consumers in most cases have ideal departure and arrival times in mind that best fit their travel purpose. In reality, if regular public flights are used, it is, however, very unlikely that these times will be exactly met by a scheduled flight. The difference between desired and offered departure times is defined as ‘schedule delay’.\textsuperscript{389} Obviously, the larger the observed schedule delay, the higher is the perceived disutility of a particular flight. Looking on the purpose of the trip, Koppelman and Proussaloglou also showed that the impact of schedule delay is higher for business than for leisure travelers. This is mainly driven by the fact that business travelers exhibit higher time costs than leisure travelers (cf. also chapter 4.3.2.2).\textsuperscript{390}

Of particular interest, though, is the finding that the disutility of a schedule delay follows a non-linear function, i.e. passengers usually accepts a departure within a certain time range at a low disutility, before the perceived disutility strongly increases after an inflexion point has been reached. In the course of modeling the disutility of schedule delay based on large datasets, Koppelman et al. in 2008 found that the best representation is given by means of an S-shaped curve, which means that once a certain schedule delay is reached, the marginal disutility increase becomes slower again. Since a differentiation between early schedule delay (i.e. the flight leaves earlier then preferred) and late schedule delay did not improve the model quality with regard to explaining customer behavior, the disutility function can be illustrated by an S-shaped curve which is mirrored along the ideal departure time (cf. Figure 64).\textsuperscript{391}

\textsuperscript{389} Cf. Koppelman / Proussaloglou (1999), p. 195
\textsuperscript{390} Cf. Koppelman / Proussaloglou (1999), p. 195ff; This also explains the benefit of a high flight frequency for business travelers. With increasing frequency, the difference between desired and actual departure time narrows, which improves the attractiveness of the flight program as a whole. Other studies also suggest that travelers put more emphasis on avoiding schedule delay on the outbound than on the return flight (cf. Garrow (2009), p. 250).
\textsuperscript{391} Cf. Koppelman / Coldren / Parker (2008), p. 272
The incurred disutility in case of schedule delay

4.3.2.4 The role of the itinerary (non-stop or indirect flights)

In the course of the evaluation of different itinerary options, passengers also have to take into consideration whether an alternative includes a connection or not. Besides leading to a prolongation of the overall travel time, a connection for many passengers also deteriorates their travel experience, since it requires them to walk from one gate to another, eventually pass additional safety controls and, more generally, also adds the risk of missing the connection flight to their trip. In their analysis of (enriched) booking data of US flights, Coldren et al. found a clear preference of passengers for direct flights. When having to choose among itineraries with connections, there was a preference for itineraries with a short overall travel time (avoiding circuitous routings) as well as connections with a short ground time. However, later studies confined this result by showing that too short connection times again result in an increased disutility, since passengers value the risk of missing their onward flight higher than the marginal utility of additional time savings. Finally, at least for experienced travelers, the quality of the transit facilities at the airport too plays a role when it comes to selecting an itinerary.

Based on a survey among 589 passengers in the USA in 2001, Hess et al. used a multinomial logit model to determine the willingness to pay for a non-stop flight (focusing only on domestic itineraries). The results are shown in Table 24.

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392 Own illustration
393 Cf. Coldren et al. (2003), p. 365
394 Cf. Theis et al. (2006), p. 28ff
395 For instance, in 2010 Munich airport has been selected as „Best International Transit Airport“ in the course of a survey among 9.8 million travelers. Cf. Skytrax (2010), www.worldairportawards.com
The results show that especially business travelers are willing to pay a premium for a direct flight (besides their willingness-to-pay for shorter travel times). This tendency is also confirmed by a Swiss study among 2,791 passengers at Zurich airport in 2003, which found an average willingness-to-pay for an Intra-European non-stop flight of € 128 (business travelers) and €90 (leisure travelers). The values for intercontinental travel were in average 35% higher. In contrast to the US-study, the data from Zurich also includes the benefit of a shorter travel time (with connections resulting in a prolonged travel time of 3h in average).  

This finding is also reflected in the fare structure of airlines. A study of Canadian air fares in 2006 found that one-stop connections of one O&D were in average sold at discount of 15% in comparison to non-stop flights.  

4.4 Ex-ante evaluation of possible designs of flexible time-range tickets

The previous chapters have provided an overview of existing flexible products as well as the characteristics of air travel passenger demand. Based on this input and the presented commercial opportunities and constraints in multi-hub networks, the following chapter aims at further specifying the idea of flexible time-range tickets (which has already been shortly introduced in chapter 1.2) in order to be able to evaluate potential product designs in the empirical part (cf. chapter 5).

4.4.1 Evaluation of various product characteristics and selection of features for the empirical investigation

Flexible products aim at serving the low-cost segment of air travel passengers without (extensively) cannibalizing existing revenues and under consideration of operational necessities. Table 25 shows potential product characteristics in a morphological box layout.

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The original values were converted from US Dollar to Euro using the average exchange rate in 2001 (i.e. 1.117, cf. Oanda (2010), www.oanda.com).

SIAA (2003), p53 quoted in: Heitmann (2005), p. 68. The original values were converted from Swiss Francs to Euro using the average exchange rate in 2003 (i.e. 0.658, cf. Oanda (2010), www.oanda.com).


<table>
<thead>
<tr>
<th>Design element</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexible component</td>
<td>Destination (e.g. Blind Booking)</td>
</tr>
<tr>
<td></td>
<td>Flight times (e.g. Freedom Air)</td>
</tr>
<tr>
<td></td>
<td>Flight times and flight type (e.g. Air New Zealand mystery breaks)</td>
</tr>
<tr>
<td>Degree of uncertainty regarding the flight times</td>
<td>Time-range of several days possible (e.g. Freedom Air)</td>
</tr>
<tr>
<td></td>
<td>Time-range of several hours (up to one day) possible (e.g. Blind Booking, Priceline)</td>
</tr>
<tr>
<td></td>
<td>Time-range of a few hours possible (e.g. classical Standby-tickets on high frequency route)</td>
</tr>
<tr>
<td>Degree of uncertainty regarding the type of the flight</td>
<td>Only non-stop flights (e.g. Blind Booking)</td>
</tr>
<tr>
<td></td>
<td>Only flights including a connection</td>
</tr>
<tr>
<td></td>
<td>Either non-stop or connecting flight (e.g. Priceline, Hotwire, etc.)</td>
</tr>
<tr>
<td>Degree of uncertainty regarding the airline</td>
<td>Only one specified airline possible (e.g. Blind Booking, Freedom Air)</td>
</tr>
<tr>
<td></td>
<td>Several specified airlines possible (e.g. Hotwire)</td>
</tr>
<tr>
<td></td>
<td>No information given (e.g. lastminute top secret flights)</td>
</tr>
<tr>
<td>Prior notice period with regard to flexible component</td>
<td>After completion of the booking (Hotwire, Priceline, Blind Booking)</td>
</tr>
<tr>
<td></td>
<td>One week prior to departure (e.g. Air New Zealand Mystery Breaks)</td>
</tr>
<tr>
<td></td>
<td>One day prior to departure (e.g. classical Standby-tickets)</td>
</tr>
</tbody>
</table>

Table 25: Potential product characteristics of flexible tickets

In the following the listed options are going to be evaluated from a demand as well as a supply perspective in order to design a flexible product which can then be presented to potential buyers in the empirical part of this study.

With regard to the flexible component it can be noted that an uncertainty regarding the destination strongly limits the addressable target group of a flexible product. The company Germanwings, for instance, has in July 2009 only sold about 1.9% of its inventory by means of its flexible product Blind Booking, even though it directly promotes the product on the homepage of its website, which serves as the company’s main booking channel. Given the fact that the LCC Germanwings – especially in July - predominantly attracts price-sensitive leisure travelers and that the absolute fare level in July has in the last years constantly been the highest of all months of the year, which increases the attractiveness of the fixed priced offer “Blind Booking”, it is reasonable to assume that the share of travelers using this offer in other months is significantly lower. Due to this limited applicability as well as the evident empirical evidence (based on the already available implementations of flexible products that hide the destination) this approach will not be further examined in the empirical part of this study.

On the other hand, the low sensitivity of price-sensitive travelers to schedule delay (cf. chapter 4.3.2.3) indicates that there is a segment of travelers that is willing to accept an

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399 Own compilation
401 Cf. Statistisches Bundesamt (2009)
uncertainty regarding the actual flight times and flight types in return for a cheaper fare, which serves as the basic rationale for the assumption that flexible time-range tickets are able to gain a larger acceptance than flexible products that leave the destination open at the time of purchase. However, since preceding research has shown that both the value of time (cf. chapter 4.3.2.2), as well as the inconvenience of making a connection between flights (cf. chapter 4.3.2.4) still do play an important role in the selection process of leisure travelers, these components will be included in the empirical study in order to determine their relative value in the customer choice decision.

The wish to fly with a particular airline can either derive from different safety standards, benefits resulting from the membership in a frequent flyer program (FFP) or other personal preferences (e.g. catering). Since this work is focusing on European airlines, which generally share high safety standards as well as rather similar service standards, airline loyalty can mostly be attributed to the chance to earn miles in a FFP. Koppelman and Proussaloglou find that customers are willing to pay between € 8 (occasional leisure travelers) and € 87 (high-frequency business travelers) in order to fly with an airline that belongs to their FFP. While this shows that business travelers place emphasis on flying with a particular carrier, it also shows that occasional low-cost travelers do not. This indifference towards the actual airline among price-sensitive airlines is also confirmed by more recent studies - which also emphasize that this decrease of loyalty is especially prominent among online airline customers. Since European airlines that form multi hub networks are – de facto – in all cases part of the same FFP, passengers using a flexible time-range ticket could be guaranteed to fly with a safe airline that allows them to collect miles, which would even further diminish the relevance of flying with a particular airline. As a consequence, this factor is not going to be particularly modeled in the choice experiment in the empirical part. Instead, passengers will be told that the flight would be operated by a safe airline of a known airline group that offers an average level of in-flight services.

The moment at which the formerly unspecified flexible product component is specified by the supplier can be pinpointed as a fundamental structural difference between the presented flexible products. While most products (e.g. Germanwings’ Blind Booking, Condor’s Joker fliegen, Lufthansa’s ‘Surprise and Fly program’, Priceline, Hotwire and Travelocity) inform the customer directly after the booking process of the assigned product alternative, only flexible products such as Freedom Air’s Interactive Price Mechanism, Air New Zealand’s Mystery Breaks, classical standby-tickets as well as Roulette Hotels postpone the assignment time. While the former can serve as a price discrimination strategy that allows providers to effectively serve low-cost segments without having to cannibalize revenues from classical booking channels, it is only the latter type of products that allow companies to benefit from the risk pooling advantages described in chapter 3.3.3.2. Therefore, while it is obvious that a postponement of the

402 Cf. Koppelman / Proussaloglou (1999), p. 199. The original values were converted from US Dollar to Euro using the average exchange rate in 1994 (0.84518, cf. Oanda (2010), www.oanda.com), which has presumably been the year of data collection. In a second step the values were adjusted for inflation.
assignment is required in order to increase the capacity utilization of all flights in a multi-hub network, it has to be examined how different notice periods affect the perceived uncertainty of customers. For this reason, the notice period will be modeled as a factor in the empirical study.

In order to make sure that the concepts which are going to be examined in the empirical part are feasible solutions, the following section aims at briefly giving an overview, whether the proposed concepts would be applicable from a legal as well as an operational perspective.

4.4.2 Compliance of the proposed flexible time-range ticket concepts with current legislation

Since many consumer protection regulations in the airline industry are based on the flight times as an integral part of the contract with the passenger, it is worth examining, whether a postponement of the assignment of the customer to a specific flight is in line with current laws.

Already now, many airlines use clauses in their Conditions of carriage (CoC), which enable them to change the flight times of a customer after the booking has been completed (cf. as one of several available examples, Lufthansa CoC, Article 9.1.1):

“The flight times shown in timetables may change between the date of publication and the date you actually travel. We do not guarantee them to you and they do not form part of your contract with us.”404

After a complaint by a Ryanair customers, whose flight times were significantly changed, the County Court of Cologne405 has ruled that according to the German Civil Code (§§ 305ff), flight times must form a compulsory element of a transportation contract, which forced many airlines to adopt their conditions in order to comply with the law.406 In the case of Lufthansa this case is regulated by paragraph 9.1.2. of their CoC, which reads as follows:

“[…] If, after you purchase your Ticket, we make a significant change to the scheduled flight time, which is not acceptable to you, you will be entitled to a refund [...].”407

With regard to flexible time-range tickets, this accentuates the need to be absolutely clear to the customer regarding the assignment of flexible departure and arrival times which by definition are going to change once that the customer is assigned to a specific flight alternative in order to comply with these regulations.

404 Lufthansa (2010a), www.lufthansa.com
405 County Court Cologne, 29.01.2003, 26 O 22/02.
407 Lufthansa (2010a), www.lufthansa.com
4.4.3 Evaluation of the feasibility of an integration of flexible time-range tickets in the airline process landscape

4.4.3.1 Integration into currently used software systems

In order to be able to sell flexible time-range tickets, airlines would have to make sure that their current IT-landscape is able to process them.

In contrast to many LCC who almost exclusively sell their inventory through their own website, which serves as an interface to a simple Computer Reservation System (CRS), network airlines traditionally use sophisticated Global Distribution Systems (GDS) to offer and sell their tickets. In Europe, the largest GDS provider is the company Amadeus, which in 2007 had a market share of 55% (followed by Galileo, Sabre and Worldspan with 23%, 14% and 8% respectively).408 GDS allow external sales agents to access and sell the inventory of an airline through a standardized interface, thereby increasing the customer reach of airlines and speeding up the sales process.

Currently used GDS platforms by default do not allow the user to accept a booking request without specifying the flight routing. If a passenger is rebooked at a later moment, either a currently available (usually higher) booking class has to be chosen or a formerly available booking class has to be opened manually, which results in high transaction costs. Therefore it has to be noted that presently used GDS do not support an implementation of flexible time-range tickets.409 Recent product developments, such as the Amadeus-developed ‘trip-finder’ tool, which allows passengers to search for flights based on their budget instead of having to specify date and destination, indicate, though, that GDS-vendors too are aiming at enabling airlines too offer more innovative products.410

This move can also be understood as a response to the rising importance of the internet, which allows airline to sell directly to the customer via their website at a fraction of the costs that occur when tickets are sold through a GDS. As a result, the role of GDS has strongly decreased during the last years.411 While in 2000, still 80% of the revenue of airlines has been made through traditional travel agencies with only 1% of tickets being sold through the internet,412 in 2009, for instance Lufthansa has already sold 25% of its ticket via its own website.413 Many airlines have even – at least temporarily - restricted certain discount fares to their websites (partly also to overcome the limitations

408 Cf. Lovell (2007), p. 18. The market share is measured as the percentage of all GDS bookings. Amadeus was founded by several European airlines in 1987 in order to establish a European CRS. Today still approximately 45% of the shares of Amadeus IT Group SA are owned by Air France, Lufthansa and Iberia.

409 Cf. Expert interview Oswald (2009)

410 Cf. Sobie (2010b), www.flightglobal.com

411 Cf. Alamdari (2002), p. 341. In the year 2000, airlines that were selling tickets through GDS in average paid between 2-4% of the sales volume as a transaction fee to the GDS-vendor. This considerable amount can be saved if bookings are directly entered into the airlines reservation system (through the companies website). If airlines do not operate their own CRS and only use their website as an additional access point to the GDS, they cannot totally avoid GDS fees but often profit from a reduced rate.


413 Cf. Sobie (2010b), www.flightglobal.com
of CRS with regard to selling ancillary services such as paid seat assignments or lounge access). To give travel agents again access to the entire range of available tickets, GDS-providers gave airlines incentives (in the form of cheaper booking fees) if they enter so-called “full-content agreements”, which do not limit the availability of tickets.\textsuperscript{414}

Not only that from the cost perspective an airlines own website is the best channel to sell low-fare tickets, a survey among 996 airline ticket buyers in 2007 has also shown that “the higher the level of respondents’ price consciousness and sale proneness, the higher the probability of them adopting Internet as their retail channel.”\textsuperscript{415}

In conclusion, there are three main arguments, why a flexible time-range ticket should primarily be sold via the website of an airline that wants to offer it. First of all, since classical GDS at the moment do not support more sophisticated ticket forms, the airline would have to use its own website as a sales channel from a technical point of view. In order to transform the reservations into confirmed bookings at a later time, a middleware system (cf. the IT architecture used at Freedom Air’s Interactive Price Response System as shown in Figure 58) could be used. Second, since flexible products are priced at a discount in comparison to specified tickets, it is also economically sound to only offer them through the cheapest sales channel, i.e. the company’s website. Finally, the internet is also the retail channel which is preferred by price-conscious customers, which form the key target group of flexible products.

An analysis of the capabilities of current Yield Management systems shows a similar outcome. Although current procedures do not foresee flexible products, this deficit could be bypassed by means of connected middleware systems. Given the huge developments in computational power as well as more and more advanced algorithms applied in the field of airline operations optimization, it is also reasonable to assume that a joint management of fares and capacity across several airlines is not hampered by insufficient computational power.\textsuperscript{416} However, since there is nowadays often only little coordination between revenue management departments within recently formed airline groups (e.g. between Austrian Airlines and the respective department at Lufthansa), the main challenge lies in the organizational alignment of various departments as well as in the introduction of common IT-platforms and data standards.\textsuperscript{417}

\subsection*{4.4.3.2 Passenger and luggage handling}

The main process steps of passenger handling are the check-in at the airport, safety and (where needed) passport controls as well as the boarding of passengers and luggage. With regard to flexible time-range tickets there would in most cases be no change to existing routines, with the exception of the check-in process as well as eventual passport controls. These cases will be shortly discussed in the following.

\textsuperscript{414} Cf. Pilling (2009), p. 31
\textsuperscript{415} Yua (2008), p. 68
\textsuperscript{416} Cf. Snowdon / Paleologo (2008), p. 20-1
\textsuperscript{417} Cf. Expert interview Oswald (2009)
An examination of check-in times at Frankfurt Airport revealed that the check-in process usually lasts between 1.6 and 2.2 minutes per passenger.\textsuperscript{418} If passengers who have purchased a flexible time-range ticket are only informed about their flight times at the check-in counter, it is likely that they will have additional questions with regard to the assigned routing, the involved carriers and the (potentially) incurred waiting times, which could result in longer process times and therefore also increased costs. This cost increase would counteract the efforts taken by airlines in the last years to promote self-service channels such as kiosks at the airport or web check-in. According to an analysis done by a vendor of self-service-terminals these terminals are able to reduce the check-in costs from $3.68 using human agents down to $0.16 per process.\textsuperscript{419} Since an assignment of passengers holding flexible time-range tickets to a specific flight only at check-in would eliminate the possibility of an online check-in airlines would at least have to offer self-service terminals which are able to process these passengers in order to avoid low-fare passengers causing additional costs during manual check-in processes.\textsuperscript{420} Based on these arguments, an assignment of passengers to a specific flight only at check-in cannot be recommended from a cost perspective.

With regard to the design of flexible time-range tickets it has to be ensured that travelers have all relevant travel documents that are required on each of the potential flight alternatives. In a European context this for instance means that all potential hubs should be located in the Schengen area (since travelers from outside of the European Union are usually given a visa that entitles them to travel in the entire Schengen area and not only in the final country of their trip).

\textsuperscript{418} Cf. Barckhausen (2009), http://www1.tu-darmstadt.de
\textsuperscript{419} Cf. Kis Kiosk (2005), www.kis-kiosk.com
\textsuperscript{420} Cf. Klein / Klingler (2009), p. 61f
5 Empirical analysis of the acceptance of flexible time-range tickets

The preceding chapters have presented the challenge of network carriers to (profitably) compete with LCC on routes where they face direct competition. Furthermore, it has been shown how flexible products could be used in a multi-hub environment in order to address price-sensitive travellers. Based on existing studies about the characteristics of demand, the potential design of flexible time-range tickets has been narrowed down. The following chapter now aims at reviewing customer behaviour in greater detail by means of an empirical study in order to be able to evaluate certain product characteristics of flexible time-range tickets and quantify, how many customers would be willing to purchase the respective products. The empirical study is divided into a qualitative pre-study and a cross-sectional confirmatory study.

First, in an explorative study several in-depth qualitative interviews were conducted. The respondents were selected based on theoretical sampling, i.e. the purpose of the sampling was not to generate representative results for a certain population but to increase the marginal information gain of each interview. The study aimed at identifying customer preferences and restrictions regarding the design of flexible time range tickets which play a major role in determining the acceptance these tickets.

Second, a large scale online survey was conducted. Besides testing the importance of potential product components (e.g. information time, knowledge of potential routings) the main aim was to determine which customer segments would be attracted by flexible time-range tickets. Furthermore the acceptance of various ticket conditions shall be examined. Overall this follows the classical setup of an explorative study that aims at generating hypotheses, which are then empirically tested in a quantitative study.421

5.1 Qualitative study of flexible time-range tickets

5.1.1 Design and objectives of the pre-study

Given the lack of existing research with regard to the possible design and the acceptance of flexible time-range tickets, there are no given theories which provide a possible explanation of consumer behavior in this situation and might be empirically tested. Therefore, as a starting point of the empirical research of this dissertation, a qualitative survey has been conducted to develop customer typologies and generate research hypotheses. The main research objective at this stage was to find out, who accepts or rejects flexible time-range tickets, why people do so, and how the ticket could be designed in order to achieve a high acceptance. Special emphasis was given to the potential fears of customers with regard to the actual routing as well as the question,

421 Cf. Diekmann (2008), p. 188
which information is required at certain points of the booking process (and the time prior to departure) and how this information should be conveyed. Prior to the discussion of these research aspects, the interviewees were given an explanation of flexible time-range tickets that included a concrete example to illustrate the concept.

In total eleven non-standardized, face-to-face interviews were conducted in July 2009.\textsuperscript{422} In order to capture as much individual and qualitative information as possible, the interviews did not follow a strict structure but only a rough guideline (cf. appendix 1) and allowed the respondents to focus on certain parts that were of higher importance to them.\textsuperscript{423}

The selection of respondents did not aim at obtaining a representative sample but rather to maximize the marginal information gain of each additional interview. This approach of ‘theoretical sampling’ has been introduced by Glaser and Strauss in 1973 and aims at revealing specific categories and properties in order to develop theories of behavior.\textsuperscript{424}

> “Theoretical sampling is the process of data collection for generating theory whereby the analyst jointly collects, codes, and analyzes his data and decides what data to collect next and where to find them, in order to develop his theory as it emerges.”\textsuperscript{425}

Theoretical saturation was reached after eleven interviews with a diverse group of respondents (cf. Table 26). This means that the marginal information gain of additional interviews was deemed to be insignificant, thus no more samples were taken.\textsuperscript{426}

\textsuperscript{422} Personal face-to-face interviews were selected to allow respondents to ask questions in case the procedures of the researched ticket type were not clear. Cf. Diekmann (2006), p. 443 ff; More information about the interview process is provided in Nernst (2009).

\textsuperscript{423} Cf. Atteslander / Cromm (2003), p. 120 ff.; Diekmann (2006), p. 371 ff.; To include new points that came up during the first interviews, the guideline was also slightly adjusted.

\textsuperscript{424} Cf. Glaser / Strauss (1973), p. 62

\textsuperscript{425} Glaser / Strauss (1973), p. 45

<table>
<thead>
<tr>
<th>Respondent: Name, Age &amp; occupation</th>
<th>Flights per year</th>
<th>Most important flight selection criteria</th>
<th>Acceptance of flexible time-range tickets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adhe K. (29), Employee</td>
<td>10 (70% business, 30% vacation)</td>
<td>Reputation of the airline and departure time</td>
<td>YES</td>
</tr>
<tr>
<td>Charles M. (65), Professor</td>
<td>12 (80% business, 20% family visits)</td>
<td>Price</td>
<td>YES</td>
</tr>
<tr>
<td>Christoph M. (33), Manager</td>
<td>15 (90% business, 10% vacation)</td>
<td>Departure and arrival time for business, price for vacation</td>
<td>YES</td>
</tr>
<tr>
<td>Dr. Frauke K. (46), Employee</td>
<td>2 (vacation)</td>
<td>Reputation of the airline</td>
<td>NO</td>
</tr>
<tr>
<td>Heide N. (66), Retiree</td>
<td>2 (family visits)</td>
<td>Price and reputation of the airline</td>
<td>NO</td>
</tr>
<tr>
<td>Georgia M. (n.a.), Manager</td>
<td>8-12 (mostly business)</td>
<td>Time for business flights, price for pleasure flights</td>
<td>YES</td>
</tr>
<tr>
<td>Nicole S. (24), Student</td>
<td>1 (language vacation)</td>
<td>Price and security</td>
<td>YES</td>
</tr>
<tr>
<td>Dr. Ralf N. (55), Independent IT Consultant</td>
<td>12 (90% work, 10% vacation)</td>
<td>Fast and direct connection, for private flights also price</td>
<td>YES</td>
</tr>
<tr>
<td>Sebastian S. (23), Student</td>
<td>7 (50% education, 50% vacation)</td>
<td>Price</td>
<td>YES</td>
</tr>
<tr>
<td>Sonja F. (34), Employee</td>
<td>10 (80% business, 20% vacation)</td>
<td>Departure and arrival time</td>
<td>YES</td>
</tr>
<tr>
<td>Wolfgang W. (55), Employee</td>
<td>4 (70% business, 30% vacation)</td>
<td>Price</td>
<td>YES</td>
</tr>
</tbody>
</table>

Table 26: Interviewees
5.1.2 Results of the exploratory pre-study

During the qualitative interviews, the respondents were asked about their acceptance of flexible time-range tickets (and its determinants), their information requirements and potential fears.

5.1.2.1 General acceptance and its determinants

Quite unexpectedly it turned out that the vast majority of the respondents (9 out of 11) would accept flexible time-range tickets in their relevant set. The respondents rejecting it stated their preference for reliable airlines and the desire for fixed arrangements at the beginning of their holidays as main reasons. However, with regard to the remaining persons, many respondents made their acceptance dependent on certain conditions.

First of all the purpose of the trip was a clearly stated criterion with regard to the suitability of flexible time-range tickets. Unanimously respondents stated that the attached uncertainty with regard to the precise arrival time is unsuitable for business trips, since they cannot arrange a meeting time with business partners in advance. Furthermore when travelling on business purpose, the respondents valued their time too high in order to spent it unproductively at airport gates while waiting for a connecting flight (which might be the case if they are assigned to a routing that involves a transfer). On the other hand, the concept was attractive to leisure travelers, especially when thinking of longer travel periods.

Personal characteristics, such as age or air travel experience as well played a role in determining the likelihood of an acceptance of the concept. While younger respondents expressed a positive, flexible attitude towards flexible tickets in case they allow them to save money, some older respondents considered it problematic to only receive their arrival time shortly prior to departure, because this would make it more difficult to arrange transport from the airport to the final destination or their hotel (which they, especially in case their mobility is impaired, strongly rely upon). Furthermore the interviews indicated that people who fly often, are (with regard to private trips) more likely to accept the new ticket type.

Some respondents also linked the attractiveness of the ticket to the size of the travel group, since the disutility of longer travel times was considered to be smaller if the time is spent together with friends or relatives.

Finally the acceptance of the respondents was in all cases connected to the achievable saving in comparison to a fully specified booking. Many interviewees said that they would outweigh the expected additional time consumption with the monetary saving. If they consider the overall potential travel time as too long they would refrain from selecting the ticket. Interestingly, in the decision process, besides the relative saving that can be achieved many respondents also said that they would only consider the ticket if the amount saved exceeds a threshold amount (in one case €20 were stated), thereby considering it a viable alternative especially in case of flights where regular tickets are rather expensive.
5.1.2.2 Information requirements and desired product characteristics

During the interviews the potential customers were told that when booking a flexible ticket they would be informed about price, origin & destination as well as the earliest departure and the latest arrival time. Beyond these points many respondents asked for additional information concerning the following points:

- **Knowledge of possible routings**
  In order to better be able to assess the value of flexible time-range tickets, several respondents asked for more details with regard to the flights that are in the set of possible alternatives (involved airlines, possible transfer airports, flight times, etc.). On the one hand this was asked by frequent flyers that due to bad experiences wanted to avoid certain airlines or airports, while on the other hand this issue has also been very important to people who seldom fly and place special emphasis on selecting an airline that is renowned for high safety and quality standards. Some respondents even indicated that they would pay a small surcharge to either exclude certain undesired airports or airlines, or to add preferences for certain routings.

- **Frequent Flyer Program (FFP)**
  For members of a FFP, it is important to know, whether they can collect miles on the flight to which they will be assigned. One interviewee suggested that the selling airline should award a certain amount of miles irrespective of the actual routing.

- **Single Point of Contact**
  In case of problems or questions, potential passengers would like to know whom to contact. Ideally in the eyes of many respondents, this should be the airline that has accepted the booking, not necessarily the operating carrier.

- **Consistent Terms & Conditions**
  Irrespective of the final airline, the respondents expected to be informed during the booking process about the applicable terms and conditions (e.g. luggage allowance, refund & cancellation policies)

When asked about the time frame prior to departure in which they would like to be informed (at the latest) about the final routing, all respondents stated one day as their ultimate limit, with a few preferring to receive the information at least one week in advance. Two younger respondents also expressed their willingness to be informed only at a specified check-in time on the departure day, if this is reflected in a larger discount (approximately 40%) in comparison to a regular ticket.

Besides the actual flight and the operating airline travelers should also be informed at which terminal they have to check in. With regard to the preferred information channel there was a clear preference among the respondents for channels that allow them to confirm the receipt (e.g. an email with a confirmation link or a telephone call).

5.1.2.3 Fears of potential customers and measures to alleviate them

Since flexible time-range tickets do not specify certain product parameters at the time of booking, they involve uncertainty for the purchasers. During the interviews the
respondents were asked to state explicitly what they would be worried about and how their fears could be decreased.

In line with the desire to know which airlines and airports are in the potential set of flights, some interviewees were afraid of flying with an untrusted airline or to having to change planes at an unknown or disliked airport. These worries could be countered by informing potential customers about all possible routing alternatives.

Other respondents raised concerns about the availability of free seats on their requested date or the actual arrival being after the announced latest arrival time (even though they were told that by booking a ticket they will definitively be transported within the given timeframe). This requires the airline to emphasize this point during the booking process in order to clearly state the difference to ‘classical’ standby-tickets, where passengers are not guaranteed anything, but have to wait for the next available seat.

In case the flight is part of a tour package that includes a transfer to the hotel, passengers would be afraid that their pick-up service is not informed about the actual arrival time. Another fear is that the actual arrival is too late in the evening and does not allow passengers to continue their travel to their final destination (e.g. by means of public transport). At destinations with infrequent onward transport connections this might decrease the applicability of flexible time-range tickets for travelers that usually use public transport. In their evaluation of different ticket options, these travelers would add the cost difference between public transport and a potentially required taxi to the cost of the flight ticket, thereby narrowing the cost advantage of flexible time-range tickets.

5.2 Research hypotheses

Based on the conducted qualitative interview, the stated research aims and the preceding literature review the following set of hypotheses was generated prior to conducting the quantitative survey.
### Research hypotheses for empirical part

| H1 | Leisure travelers are more likely to accept flexible time-range tickets than business travelers. |
| H2 | The perceived self-confidence with regard to flight booking behavior is positively related with the likelihood to select a flexible time-range ticket.\(^{427}\) |
| H3 | Passengers that usually travel alone are less likely to select a flexible time-range ticket than passengers travelling in a group. |
| H4 | Consumers that have the choice between a specified flight and an unspecified flexible time-range flight prefer the specified flight. |
| H5 | The earlier the flight assignment time (information about actual routing), the more likely is the selection of a flexible time-range ticket. |
| H6 | The shorter the potential time-range, the more likely is the choice of a flexible time-range ticket. |
| H7 | The likelihood to accept a flexible time-range tickets as a function of a given price reduction is not following a linear but rather a logistical function. Unless a certain minimum discount is granted customers are hardly considering flexible tickets as an alternative at all. There is a saturation point, after which the marginal increase in acceptance triggered by additional discounts decreases. |
| H8 | Flexible time-range tickets can induce additional demand. |

#### Table 27: Research hypothesis for the empirical part

### 5.3 Quantitative examination of hypotheses

#### 5.3.1 Parent population and survey mode

In order to examine the raised hypotheses a sample of airline travelers was recruited. The underlying target population consisted of all Austrians aged above 18, who have at least travelled one time by means of an airplane during the last 12 months. The latter criterion has been added as a proxy variable in order to ensure that only people with at least certain knowledge of the air transport market were able to participate, since this was deemed necessary in order to properly assess the value of flexible time-range tickets.\(^{427}\)

\(^{427}\) The intangible nature of transport services makes it more difficult for the consumer to assess the service quality prior to the purchase. In this setting, the price as such becomes a relevant substitute indicator for the quality of a product, which ultimately results in the acceptance of higher prices by insecure customers. Therefore potential consumers with little knowledge about air traffic processes might be reluctant to purchase a flexible time-range ticket although it is cheaper than a regular specified ticket. Cf. Friesen (2008), p. 77 or Bruhn / Meffert (2003), p. 518f.
tickets. As a study conducted in Germany in 2009 shows, only 30% of the general population has travelled via airplane during the last 12 months (cf. Figure 65).

![Number of flights in the last 12 months (general population)](image)

To reach a substantial amount of diverse respondents, the prevailing study survey was executed in cooperation with an online access panel provider, who (within the group of people aged above 18) invited a randomly chosen set of panelists based to participate. To avoid a self-selection bias, the topic of the survey as well as the screen-out criterion (at least 1 flight during the last year) was not disclosed in the invitation email. Based on a quota selection it was then ensured that the sample was representative of the parent population with regard to the criteria age, gender and education.

In general, a large disadvantage of computer-assisted web interviews (CAWI) is the phenomenon of under-coverage. Since not everybody has access to the internet, certain people of the target population do not even have the chance to participate in a study, which undermines the goal of creating an Equal Probability of Selection Method (EPSEM) sample. With regard to airline travelers this problem seems negligible, though. As Table 28 demonstrates, the internet is predominantly used by male as well as by younger persons. As these groups are also overrepresented (in comparison to the general population) among airline passengers (especially leisure passengers, who are also the assumed key target group of flexible tickets), an online survey is deemed to be an appropriate survey mode to examine the target population of airline travelers.

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428 Cf. Statista (2010), www.statista.de; Institut für Demoskopie Allensbach, quoted in Focus (2010), focus.de. The data from Germany is taken as an approximation for Austria since no comparable statistics are publicly available for the Austrian market.

429 Cf. Diekmann (2008), p. 526
### Table 28: Demographic structure of internet user and airline travelers

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Male</th>
<th>Female</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>14-19</td>
<td>10%</td>
<td>13%</td>
<td>19%</td>
<td>21%</td>
</tr>
<tr>
<td>20-29</td>
<td>15%</td>
<td>19%</td>
<td>19%</td>
<td>23%</td>
</tr>
<tr>
<td>30-39</td>
<td>16%</td>
<td>18%</td>
<td>27%</td>
<td>27%</td>
</tr>
<tr>
<td>40-49</td>
<td>14%</td>
<td>14%</td>
<td>17%</td>
<td>28%</td>
</tr>
<tr>
<td>50-59</td>
<td>12%</td>
<td>8%</td>
<td>9%</td>
<td>28%</td>
</tr>
<tr>
<td>70+</td>
<td>14%</td>
<td>4%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The suitability of online surveys in the field of airline passenger research is also amplified by the fact that in 2009 already 1.15 billion airline tickets were sold via the internet (either directly through an airline website or through online travel agencies) which represents 44% of all sold tickets.

### 5.3.2 Demographic structure of the sample

After a pretest with 20 people in July 2010, from 14 January to 22 January 2011 in total 553 Austrian residents were invited to participate in the actual survey. On the entry page, respondents were asked how often they have been travelling by plane in the last year. As a result, 29% of all respondents who did not fly at all in the preceding 12 months were screened out (cf. Figure 66).

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430 Cf. Austrian Internet Monitor (2010), mediaresearch.orf.at; Flughafen München (2009), www.munich-airport.de; Berliner Flughäfen (2011), www.berlin-airport.de. Munich and Berlin were selected since they on the one hand disclosed their passenger structure grouped according the demographic criteria which were also of interest in the current study, and on the other hand because they offer good examples for a business-passenger orientated airport with a large share of network airlines (Munich) as well as a rather leisure-passenger orientated airport with a large share of LCC (Berlin-Schönefeld).

431 Cf. Tunnacliffe (2010), p. 69
As expected, based on the strong overlap between airline travelers and internet users, the share of questioned Austrians without any flights in the last year was significantly lower than the aforementioned reference data from Germany (which has been collected by means of a telephone survey) would have suggested. Furthermore this can also be explained by the fact that the amount of passengers carried per capita in Germany (1.9) is by around 27% lower than the respective figure for Austria (2.6).432

Out of the 390 respondents who – based on their flight behavior – qualified for the main survey, 356 finished the survey and thereby form the basis for the following analyses.433 Table 29 shows the demographic structure of the sample, which with regard to the characteristic age and gender corresponds very well with the passenger structure at Munich and Berlin airport (see table above).

433 Besides regular dropouts, five respondents were also excluded since they passed the survey in a time which was (based on the pretest) considered as unrealistic in order to give meaningful answers. The average survey duration (among finishers) was 14 minutes and 25 seconds.
When asked about the predominant purpose of their flight trips in the last year, 64 respondents (18%) said that they were mostly travelling on business purpose, while the remaining 292 (82%) declared themselves as leisure travelers. There has been a highly significant difference between the average amount of return trips per year between the two groups (t-test: p < 0.001): while business passengers in average completed 9.6 trips per year, leisure travelers embarked in average on 3.0 return flights per year.

By multiplying the amount of travelers with the average number of trips in the respective categories, it turns out that business travelers are responsible for 41% of all 1504 trips which were made by the group of respondents. Although this is higher than the 26% share of business trips, which the Austrian Office of Statistics has calculated for 2009 (which, due to the financial crisis has been a year where many companies have reduced their travel expenses), the obtained figure is well in the middle of the figures published by Munich airport (48% business passengers), Berlin Tegel (42% business travelers) and Schönefeld airport (with 19% of all passengers traveling on business purpose).

In average, business travelers in the sample are younger than leisure travelers. Furthermore, they are predominantly male and in average have completed a higher level of education than respondents who stated leisure as their dominant trip purpose.

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The respondents were also asked how many of their trips have been done using LCC.\textsuperscript{435} In average, while average leisure travelers made 51\% of their trips using LCC, business travelers in average only used LCC for 38\% of their trips. The difference in the means of the two groups was found to be significant (t-test: $p = 0.019$). The correlation between trip purpose and propensity to use LCC is also found if travelers are grouped according to their individual LCC-share ($\chi^2$-test, $p: 0.003$). While the majority of business travelers (56\%) used LCC for not more than one third of their trips, 41\% of leisure travelers used LCC in more than 66\% of all cases (cf. Figure 67).

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure67.png}
\caption{Share of business and leisure travelers who traveled in $x\%$ of cases with LCC (n=356)}
\end{figure}

Overall, 569 of all 1504 trips which were made by the respondents in the last year were made using LCC, which translates into a market share of 37.8\%. This corresponds very well to the market share (measured in passengers) that LCC have achieved in Germany (35.7\%) in 2009.\textsuperscript{436}

In average, travelers made their trips together with another 1.4 persons who have accompanied them. However, there has again been a highly significant difference between business travelers (mean group size 2.03) and leisure travelers (mean group size: 2.52, t-test, $p=0.009$). 42\% of business travelers usually travel alone, while the majority of leisure travelers (52\%) in most cases travel in a group of two (cf. Figure 68).

\textsuperscript{435} In the question text, LCC were defined by giving the examples of Flyniki, Air Berlin, Germanwings and Ryanair in contrast to traditional airlines such as Austrian Airlines, Lufthansa or Air France.

\textsuperscript{436} Cf. Deutsches Zentrum für Luft- und Raumfahrt (2010), p. 11. The German data is provided as an approximation for Austria, since no comparative figures are published by Austrian sources.
Overall it can be said that with regard to the presented travel characteristics, the sample is well representing the Austrian air travel market.

5.3.4 Booking behavior

In order to better be able to describe (at a later point) the characteristics of people who consider flexible tickets as a viable option, the booking behavior of respondents was analyzed. This is of special importance for airlines when it comes to marketing a new product, since the knowledge of preferred booking channels as well as advance booking periods allows for a more precise positioning of the product.

The vast majority of the sample (79%) stated that they are usually booking flights on their own. People who delegate the booking process primarily comprise business travelers (in this group, 34% of all travelers do not book their tickets themselves).

76% of the **people who book their flights themselves** use an internet-powered sales channel. While 41% directly purchase their tickets on the website of an airline, 35% use online travel agencies (such as Expedia, Opodo or others). Only 22% of people who are personally taking care of buying their flights make use of the services of traditional travel agents. A small fraction (3%) uses other channels such as tour operator hotlines or airline sales offices. When asked to judge their perceived self-confidence with regard to always selecting the best available flight, the average rating on a 7-point Likert-scale was 2.8 (cf. Figure 69).
Travelers who delegate the flight booking process (21% of the sample) in most cases entrust a travel agent (41% of all respondents in this group) or the travel office of their company with booking their flights (24% of all respondents in this group). The remaining respondents ask friends or relatives to book their flights, who then in most cases use the website of the airline or an online travel agent as a sales channel to actually purchase the flight. Summing up flights directly booked by travel agents, and purchase processes where the consumer first asks another person which then again makes use of a travel agent, 51% of all flights from persons who do not manage the booking process themselves are booked through a travel agent. The second most used channel within this group are travel offices of the company of the passenger (24%), followed by the website of an airline (16%) or an online travel agency (8%). When it comes to selecting the actual flight, 58% of the respondent group who delegate the flight booking process still describes their influence on the flight selection process as “high” or even “very high”. 16% of the respondents in this group, however, said that they do not have any influence on the flight selection process (cf. Figure 70).
When all passengers are taken into consideration, airline websites are the most often used sales channel (35%), followed by online travel agencies (29%), traditional travel agents (28%), the companies travel office (5%) and other channels (2%). What stands out, is the dominance of internet-bound sales channels (64%) which in the sample is even higher than the share of tickets who were globally sold via the Internet in 2009 (44%).\textsuperscript{437} This can on the one hand be explained by the fact that Austria exhibits a higher internet penetration than the global average, and that furthermore even within the two years since 2009, the penetration rate has again increased by 10%.\textsuperscript{438} One the other hand, this can partly also be explained by the chosen survey mode, which requires potential respondents to have access to the internet in order to participate, thereby to some extent overestimating the importance of the internet as a sales channel.

\textsuperscript{437} Cf. Tunnacilffe (2010), p. 69
\textsuperscript{438} Cf. OECD (2010), www.oecd.org
Especially LCC heavily rely on the advance booking time as a criterion to distinguish between booking requests from business travelers and leisure travelers in their price discrimination policies. As shown in Figure 71, this criterion indeed is well suited as an approximation to identify the trip purpose and the underlying willingness-to-pay. In the sample, there has been a significant difference between the groups ($\chi^2$-test, $p<0.001$) as well as a strong correlation between the likelihood to book at a late time and the trip purpose ‘business’ (Cramér’s V: 0.38): While 67% of all business travelers book their trips within the last month prior to departure, this is only done so by 25% of leisure travelers.

When asked about the importance of certain criteria with regard to the selection of their flight, respondents overall selected the price as the most important criterion (average rating 1.78 on a scale where 1 corresponds to ‘very important’ and 7 stands for ‘not important at all’), followed by the connection type (non-stop or connection flight: 1.88) and the offered schedule times (2.10). However, as expected, significant differences were found between leisure and business travelers. While the former rated the price in average with 1.6, business travelers assigned a rating of only 2.80, giving higher priorities to other criteria, such as the convenience of the schedule, which has been rated the highest by this group (Anova, $p<0.001$). Furthermore, significant differences with regard to the importance of the price were found based on a person’s affinity for using LCC. Respondents who used LCC for at least 2/3 of their flights exhibited an even higher price sensibility (1.39) than respondents who used network carriers for the majority of their flights (2.09). An overview of all criteria is given in Figure 72.
Non-stop flights with network airlines are the most considered option, when travelers start their flight selection process (71% of travelers include this flight type in their relevant set). However, there is hardly a difference between the amount of people who consider direct flights by network airlines as a possible option and the number of respondents who consider their low-cost competitors (68%). Even worse from the perspective of network airlines is the fact that almost one third of all respondents (29%) do not even consider direct flights from network airlines in their decision making process. A more detailed analysis of this group has shown that it on the one hand consists of

- people who do not live in the catchment area of a major network airline hub (Vienna or Munich) and therefore often cannot use direct flights from these carriers as well as of
- respondents who already use LCC for more than 66% of their flights. Out of the latter, only 52% consider direct flights with network airlines (p<0.001).

Connection flights with network airlines are a viable option for 31% of all respondents, while only 18% of respondents stated that they also consider flights with LCC that serve regional airports which are one hour further away than the nearest airport (cf. Figure 73). Of particular interest with regard to the latter two groups is the fact that 63% of all respondents who are willing to accept one hour of additional journey time on the way to the airport in order to profit from lower LCC fares also accepted connection flights with network airlines in their relevant set.
As long as an airline adheres to European safety standards, 70% of travelers within the overall sample do not care with which carrier they are flying. The main reason for the desire to fly only with particular airlines is the concern about safety standards (18% of respondents). Within the sample, a good match between reported behavior and stated preference has been found: respondents who use LCC for more than 66% of their flights (39% of the total sample) were also the group that showed the largest indifference with regard to flying with a particular airline, as long as the price and the schedule meets their needs (cf. Figure 74).

Figure 73: Considered flight types in the flight selection process (relevant set)

Figure 74: Importance of flying with a particular airline
5.3.5 Acceptance of flexible tickets in relevant set

After the questions regarding their travel and booking behavior, the concept of flexible time-range tickets was presented to the respondents. In particular the respondents were shown a timeline featuring three steps:

1. One month prior to departure: Booking of the ticket at a time where the flight date is known, but the actual flight type (non-stop or connection flight) and the actual flight times are only roughly defined (time-range).
2. One week prior to departure: Assignment to a particular flight on the travel date (in the example a connection flight was used).
3. Departure date: the respondents were informed that their seat on the assigned flight is guaranteed and that they just have to check-in as usual.

Following this introduction the survey participants were asked, whether they could imagine using such a ticket. To get more realistic answers, the respondents where prompted to think of a typical trip based on their previous declarations (which, in the case of the trip purpose, were also displayed again on the screen in order to remind them). Overall, exactly 50% of all respondents answered with ‘yes’, with another 27.5% selecting the option ‘maybe’. Only 22.5% of the sample rejected the inclusion of the proposed ticket concept in their relevant set. However, with regard to demographic characteristics as well as travel and booking behavior criteria, there were significant differences between various groups (cf. Figure 75).

![Figure 75: Acceptance of flexible time-range tickets in the relevant set](image-url)
While 55% of all leisure travelers said that they would definitively include flexible time-range tickets in their relevant set, this was only the case with 27% of business travelers ($\chi^2$-test, $p < 0.001$). 44% of the latter even clearly rejected flexible time-range tickets as a feasible option. Based on this findings hypothesis one can clearly be accepted.

| H1 | Leisure travelers are more likely to accept flexible time-range tickets than business travelers. | ✓ |

Given the fact that business travelers are more likely to use network carriers, it was also not surprising to see that the acceptance rate of flexible time-range tickets among travelers who primarily use network carriers is lower than the acceptance shown by passengers who use LCC for the majority of their trips.

Based on the literature about perceived risk it was estimated that consumers with a high perceived self-confidence with regard to booking the right flight would be more likely to select flexible time-range tickets (since these are more complex to understand than regular tickets).\(^{439}\) However, no correlation of this kind was found in the data, which leads to the rejection of hypothesis two.

| H2 | The perceived self-confidence with regard to flight booking behavior is positively related with the likelihood to select a flexible time-range ticket. | ✗ |

The group size proved to have a positive influence on the likelihood of selecting a flexible time-range ticket. While only 38% of people who usually travel alone selected the answer ‘yes’ when asked whether they could imagine using flexible time-range tickets, this option was selected by 53% of all people who were traveling with at least one additional passenger (if acceptance rates are compared, the $\chi^2$-test value shows a significance level of $p = 0.047$). When parties of more than three people are looked at, the acceptance rate stands even at 60%, which means that hypothesis three can be confirmed.

| H3 | Passengers that usually travel alone are less likely to select a flexible time-range ticket than passengers travelling in a group. | ✓ |

Other criteria which proved to be of relevance were the age of travelers as well as the time between booking and departure. With regard to the age, a higher acceptance rate was on the one hand found among younger respondents (age group 18-29: 61%) as well as among older travelers (age group: 60 and above: 51%). This can be explained by the lower time costs involved by large parts of these groups (among others mostly composed of young workers, students and pensioners), which makes them more susceptible for exchanging additional travel time against a cheaper fare. Concerning the

time between booking and departure it turned out that flexible time-range tickets are most attractive for people who book their flights at least three months prior to departure.

People who did not accept flexible time-range tickets in their relevant set (22.75% of the sample) were asked for the reasons of their choice. Interestingly, the answer which has been selected by most respondents was the general dislike of unplanned things, followed by the necessity to know precise travel times in order to be able to schedule a meeting after arrival (cf. Figure 76).

**Reasons for rejection of flexible time-range tickets**

(\% of respondents; multiple answers possible, \(n=81\) respondents, who did not accept flexible time-range tickets as possible option when looking for flights)

![Graph showing reasons for rejection of flexible time-range tickets](image)

**Figure 76: Reasons for the rejection of flexible time-range tickets**

To determine the valuation of specific product components, passengers who accepted flexible tickets in their relevant set were taken further to a choice based conjoint study. Before the results are presented, the following chapter aims at providing the reader with an overview of the selected research method as well as the reason for choosing this method in an air travel context.

### 5.3.6 Conjoint Analysis as a tool to test the acceptance of and the willingness-to-pay for new products

There is a range of methods available to measure the willingness-to-pay for certain products. Depending on the way customer feedback is collected, one can distinguish between revealed preference (RP) as well as stated preference (SP) methods. Since the analysis of revealed preferences data (e.g. purchase of a specific product option) is based on real-world observations, this method achieves a very high external validity (i.e. the findings are very likely to represent the actual situation that has been analyzed). In contrast to RP-data, SP methods rely on surveys during which the respondents are asked about their preferences towards certain attributes. The resulting strength of SP methods, namely that it allows researchers to incorporate new product characteristics

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440 Other reasons mainly included the wish to avoid connections (quoted 5 times) as well as other individual points (too little expected savings, desire to avoid uncertainty when going on holidays, etc.).
into the survey by building hypothetical alternatives, is at the same time often also the
main concern of critics of SP studies, who claim that these surveys are unable to
reproduce the complex decision making process that occurs in the real world, which also
limits the transferability of the gained results.\textsuperscript{441}

However, in studies in the area of transportation that compared results obtained from
the analysis of RP to the corresponding SP data, no large discrepancies were found. As
Wardman notes, “the findings […] provide further evidence that individuals’ stated
preferences among hypothetical travel scenarios are a reasonably accurate guide to
ture underlying preferences”.\textsuperscript{442}

Other advantages of SP surveys, besides the possibility to evaluate features that
currently are not existent, are the ability to model strong variations between the distinct
attributes (which are often not found in RP data) in order to reveal the influence of
otherwise disregarded attributes, as well as the opportunity to ‘unbundle’ attributes that
are usually strongly correlated (e.g. travel time and trip costs) in order to identify the
utility impact of each of them separately. Finally, since RP studies usually only
incorporates ‘technical’ input data (such as fare, departure time, passenger numbers,
etc.) soft factors (such as seat design or the offered on-board service) are often
omitted.\textsuperscript{443}

Often the aim of SP studies in the course of the design and the pricing of new products
is to monetarily quantify the overall utility that is provided by a product that is composed
of certain attribute characteristics to a respondent. Earlier SP studies mainly relied upon
judgmental tasks, during which the respondents had to rank or rate singular attributes of
a product or service. By adding up the calculated utility of each attribute according to the
actual product design, it was then possible to estimate the overall value of a specific
alternative (compositional approach). To overcome the valid criticism that this does not
reflect the complex choice situation which customers face when they have to
simultaneously judge a number of product alternatives in order to decide for one
product that is composed of several attribute characteristics, Luce and Tuckey published a new
approach that they labeled “simultaneous conjoint measurement” in 1964, which has
been further developed (and first published in a marketing journal) in 1971 by Green and
Rao.\textsuperscript{444} By asking respondents to select an alternative that is composed of several
attributes out of a choice set, the overall value (relative to other alternatives) is obtained,
out of which the contributions of the underlying attribute manifestations are then filtered
out in order to obtain the part-worth utilities of each of them (decompositional
approach).\textsuperscript{445} By adding price as a product attribute, conjoint measurement approaches

\textsuperscript{441} Cf. Breidert (2006), p. 49 for a classification of methods that can be used to measure willingness-to-pay.
\textsuperscript{442} Many of the mentioned methods can also be used in the process of developing new products or services (cf.
\textsuperscript{444} Wardman (1998), p. 89
\textsuperscript{445} Cf. Gustafsson / Hermann / Huber (2003), p. 8
are also able to estimate the willingness-to-pay for certain products in a much more realistic way than this has formerly been done in surveys with the same aim, which, for instance, directly asked respondents what they would pay for a certain product (“direct approach”). 446

According to the widespread definition of Green and Srinivasan, who define conjoint analysis as “any decompositional method that estimates the structure of consumers preferences [...] given his/her overall evaluations of a set of alternatives that are prespecified in terms of levels of different attributes”, this decompositional approach is the main building block of all methods which are subsumed by this term. 447

During the past 40 years, however, the traditional conjoint analysis methods have been subject to a continuous development. Originally, respondents were asked to choose between two stimuli which either consisted of two factors with varying characteristics (so called trade-off or two factor method) or a full set of all included factors (full-profile method). This pair wise comparison, however, strongly limited the applicability of the method for modeling decision situations with a large amount of available options (such as air travel decisions). In order to avoid an information overload of the respondent that would lead to unrealistic answers and to restrict the survey duration to a manageable time, the amount of factors and attributes that can be included in traditional conjoint analysis (TCA) methods is clearly limited.

The Hybrid Conjoint Analysis (HCA) has been introduced to overcome this deficit by dividing the sample of respondents into homogenous groups based on a pre-survey (self-explicated model) during which they on the one hand select and rate the factors and attributes which they assume to be relevant in their decision making process and on the other hand can exclude factor attributes which would definitively prevent them from selecting an alternative. In the actual conjoint study the respondents of each homogenous group are then split up into subgroups, which are then confronted with different choice situations. As a result, the HCA analysis is able to provide part worth utilities for a large set of attributes on a group level, which limits its applicability in situations where researchers are interested in individual utility functions. 448

A subtype of the HCA is the Adaptive Conjoint Analysis (ACA). Again, the respondents at first select relevant attributes and rate their relative importance before choosing their preferred option in a set of pair wise comparisons. However, to shorten the interview process (i.e. reduce the number of choice sets) the utility function is already adapted during the interview based on the given answers by eliminating attributes which are already sufficiently defined by previous decision situations. Drawbacks of this method

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446 Cf. Breidert (2006), p. 44f. Main drawbacks of the direct approach are its unnatural focus on the price of a product as well as a potential bias of consumers to either overstate their willingness-to-pay (WTP) in order to not appear greedy or to understate their WTP in order to keep the prices of goods they might require at some point as low as possible.
447 Green / Srinivasan, p. 104
448 Cf. Gustafsson / Hermann / Huber (2003), p. 10ff; Backhaus et al. (2008), p. 451ff
are the reliance on computer-assisted interviewing modes (which allow for an automatic adaptation of the choice sets during the interview process) as well as its poor ability to correctly estimate the importance of the purchase price in contrast to other criteria.449

The Hierarchical Conjoint Analysis (HiCA) or Hierarchical Information Integration assumes a sequential decision making process, during which the respondent at first groups various decision criteria into a smaller number of perceptual dimensions (decision constructs), which are then compared to each other in a set of choice decision sets. For example, when the attractiveness of several housing options is judged, respondents would be assumed to bundle singular decision criteria such as the proximity of recreational areas or the local crime rate into decision constructs such as the quality of the neighborhood, which allows a researcher to include a large set of factors without overstraining the respondent. Based on the results of a ‘bridging experiment’ the obtained utility values for this decision construct would then be distributed on the included sub-factors. While this kind of decision process might be observed in the case of some (long-term) decisions, it is rather uncommon for many other decision situations, which also limits the applicability of this method.450

The nowadays most widely used conjoint method is the Choice based Conjoint analysis (CBC), during which respondents have to select one stimuli out of a set of (usually up to 16) hypothetical purchase options. Since CBC confronts the respondent with a setup that is very similar to the situation a consumer faces when booking a flight and is one the other hand also able to include attributes that are dependent on the characteristics of other factors (e.g. the price of a first-class flight will always be higher than the price of an Economy ticket) it has already been frequently used in an air travel context to measure customer preferences and will also be used in the following to assess the attractiveness of flexible time-range tickets.451

Potential problems of Conjoint Measurement methods with regard to the estimation of willingness-to-pay are the price effect, the range effect and the number-of-level effect.

- The price effect can be observed, if the number of attributes becomes too large, which in turn leads to an understatement of the importance of the price. It has been found that respondents are not able to properly process more than six attributes. As a consequence, facing the respondent with more attributes might lead to a violation of the underlying utility model.
- The range effect occurs, if a very wide range of attribute levels is selected to appear in a conjoint study. By presenting the respondent with rather extreme values of one attribute (such as the price), this attribute is likely to become the dominant one.

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449 Cf. Hermann / Huber / Regier (2009), p. 113ff
450 Cf. Timmermans / Molin (2009), p. 562; An advancement of the HiCA also allows the respondent to use a ‘limit card’ to exclude options which he or she would definitively not purchase, which improves the predictability of purchase decisions. However, since this Hierarchical Limit Conjoint Analysis is subject to an increased complexity it can only be done in personal interviews, which decreases its usability. Cf. Böltsch (2008), p. 122
decisive factor in the decisions of the respondent, which might lead to an understatement of the importance of other (less varied) attributes. In order to avoid the range effects, researchers should carefully calibrate the range of acceptable prices for the offered product alternatives during a pretest phase.

- A similar phenomenon occurs, if the number of offered levels of one attribute is larger than the number of levels of other attributes (number-of-levels effect), which again might give an inappropriately large weight to the concerned attribute. To overcome this problem, it is suggested to use the same (or almost the same) amount of levels for all considered attributes.452

5.3.7 Valuation of various product options (conjoint analysis)

5.3.7.1 The design of the choice-based conjoint exercise

To be able to quantify the disutility that customers purchasing flexible tickets incur due to the fact that they do not know their precise flight routing, an embedded choice based conjoint design was used.

Within the mentioned conjoint design, the basic assumptions were that customers fly with a safe airline453 that offers an average service quality between two cities that are approximately three flight hours away from each other.454 Since consumers usually do not instantly have an idea of cities that are within three flight hours from their homes, the respondents were shown a map with potential destinations. To make sure that all respondents are able to select a suitable destination, the chart included a range of typical business as well as typical leisure destinations (cf. Figure 77).

453 No real brand names were included in the example, since the affinity for certain brands was not at the focus of this study and would have aggravated the interpretation of the results (cf. also Monroe et al. (1977), p. 281).
454 A flight duration of approximately three hours was used in order to be able to also include connection flights in the choice sets, which are often no viable alternative if the flight time between two cities is shorter than 2h (due to the disproportionally large increase in the overall travel time compared to a non-stop flight).
In order to link the results of the analysis with the given answers regarding the predominant type of travel, the respondents were explicitly asked to think of a typical trip as described in their previous answers. Based on the results of the qualitative pre-study, the following attributes and levels were included in the conjoint design.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flight type and travel time</td>
<td>- Direct flight (3 hours)</td>
</tr>
<tr>
<td></td>
<td>- Connection flight (5 hours)</td>
</tr>
<tr>
<td></td>
<td>- Direct flight OR connection flight (3 or 5 hours)</td>
</tr>
<tr>
<td>Point in time when the user is informed about specific flight data &amp; time-range during which the flight will take place</td>
<td>- Specified flight (flight times already available)</td>
</tr>
<tr>
<td></td>
<td>- Time-range: 6 hours &amp; notice period: one week</td>
</tr>
<tr>
<td></td>
<td>- Time-range: 8 hours &amp; notice period: one week</td>
</tr>
<tr>
<td></td>
<td>- Time-range: 6 hours &amp; notice period: one day</td>
</tr>
<tr>
<td></td>
<td>- Time-range: 8 hours &amp; notice period: one day</td>
</tr>
<tr>
<td>Ticket price</td>
<td>- € 75 (one-way, incl. taxes &amp; fees)</td>
</tr>
<tr>
<td></td>
<td>- € 100 (one-way, incl. taxes &amp; fees)</td>
</tr>
<tr>
<td></td>
<td>- € 125 (one-way, incl. taxes &amp; fees)</td>
</tr>
<tr>
<td></td>
<td>- € 150 (one-way, incl. taxes &amp; fees)</td>
</tr>
</tbody>
</table>

**Table 30: Conjoint Analysis attributes and attribute levels**

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455 Own illustration (since the survey was conducted in Austria, German city names were used)

456 Cf. Winer et al. (1991), p. 285, who state that the factors should be selected, based on "prior knowledge or theory about what potentially 'causes' an observable outcome".
Overall, the respondents were confronted with eight random and two fixed (holdout) choice situations, which obviously is not enough to present all theoretically possible product designs \((3^4 \times 5 = 60)\). As a result, the conjoint exercise was reduced to a fractional factorial design, with a diverging number of levels per attribute (mixed design). Although an orthogonal design, which maintains the proportional frequency of occurrence of various attribute levels that also prevails in the full factorial design, would have been desirable,\(^{457}\) one restriction had to be imposed on the allowed combinations of different attribute levels in order to keep the exercise realistic, which prevented a fully proportional occurrence of attributes. This restriction ruled out the appearance of the combination of the flight type “direct flight OR connection flight” and the item “specified flight (flight times already available)”. An example of a possible choice situation for a respondent is depicted in Figure 78.

*Figure 78: Decision situation in the choice based conjoint design*\(^{458}\)

The aim of the presentation of the choice sets was to simulate a realistic decision. For this reason, the respondents were not provided with an abstract time-range but rather with explicitly stated earliest departure and latest arrival times (similar, exact flight times were also given in the case of the specified ticket. The departure times (or the start of


\(^{458}\) Illustration by the author. “Imagine you would have to travel soon on private purpose (Remark: during the interview, the respondents were asked to think of the dominant travel purpose as previously stated) to a destination which is approximately three flight hours from your home city away (Link to city map as shown in Figure 77). The following flights are offered to you. Please select the offer, which you would also choose in real life.” Within the various fictive offers, the attributes as mentioned in Table 30 are featured.
the time window) were not subject to variations, since an inclusion of the departure time as another independent variable would have drastically increased the complexity of the model at the detriment of the other attributes, which constitute the key research interest of the study. Instead, the departure times were in all cases set for the early morning hours (09:00 – 10:00), which has proven to be the most preferred departure time from the passenger perspective in a number of studies.459

5.3.7.2 Utility function and obtained part-worth utility values

Overall 275 survey participants who accepted flexible tickets in their relevant set took part in the conjoint exercise. However, due to restrictions of the academic license of the Sawtooth software package SMRT / CBC-HB which has been used to compute the part-worth utilities, only 250 respondents (i.e. 2,000 random choice tasks) were processed.

To calculate the utility values a multinomial logit (choice) model (MNL) based on the assumption of an additive part-worth utility concept was used. This utility model has been preferred to other types since the presented attribute levels (except for the price) are not metric but nominal variables and therefore are not expected to follow a linear slope (as expected by a vector model) or to exhibit an optimum value on a scale (as it is assumed by ideal point models). Furthermore an additive part-worth model assumes a compensatory relation between various product attributes, which is in line with the evidence found by preceding studies about travel choice decisions (cf. chapter 4.3.2). The calculation of the utility of an option is described by the formula below. 460

\[ u_k = \sum_{j=1}^{J} \sum_{m=1}^{M} b_{jm} * x_{jmk} \]

with:
- \( u_k \) = utility of stimulus k
- \( J \) = Number of attributes
- \( M \) = Number of attributes levels
- \( b_{jm} \) = part-worth utility of attribute m and attribute level j
- \( x_{jmk} \) = 1 if an attribute level was part of the stimulus, otherwise 0

In order to estimate, which product concept is going to be selected by a respondent, a choice model has to be incorporated. While using a ‘Max-Utility’ model would assume a fully rational decision, during which a respondent evaluates all concept attributes and then decides for the alternative with the highest overall utility, on the other hand selecting a ‘Random Choice’ model would imply that the decision is fully independent of the estimated utility scores. In the selected MNL the decision for a particular product is in general assumed to take place based on the overall utility of the included attributes, however, to take into account that individuals do not always act totally rational (see also the remarks on ‘bounded rationality’ in chapter 3.2.2), a ‘rationality’ factor \( \beta \) is added to the decision equation. This parameter regulates the extent of randomness in the decision process and is thereby able to dampen the model impact of respondents who do not decide consistently based on the expected utility function. The model has been calibrated during a total of five iterations (after which convergence of the data has been

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459 Cf. Garrow / Jones / Parker (2007), p. 283
observed) with the aim of maximizing the fit between the predicted choice decisions and the observed choice decision. With a Chi Square value of 2630 (degrees of freedom: 10; root likelihood: 0.38604) the obtained model has shown a significant difference (p < 0.005) from the null-model, which means that the composition of the attributes has a strong impact on the choice decisions by the respondents.461

The resulting main effects are displayed in Table 31

<table>
<thead>
<tr>
<th>Attribute level</th>
<th>Effect</th>
<th>Std.Err</th>
<th>t-Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct flight (3 hours)</td>
<td>1.1523</td>
<td>0.0430</td>
<td>26.7466</td>
</tr>
<tr>
<td>Connection flight (5 hours)</td>
<td>-0.6706</td>
<td>0.0492</td>
<td>-13.6066</td>
</tr>
<tr>
<td>Direct flight OR connection flight (3 or 5 hours)</td>
<td>-0.4816</td>
<td>0.0502</td>
<td>-9.5895</td>
</tr>
<tr>
<td>Specified flight (flight times already available)</td>
<td>0.5862</td>
<td>0.0589</td>
<td>9.9497</td>
</tr>
<tr>
<td>Time-range: 6 hours &amp; notice period: one week</td>
<td>0.1350</td>
<td>0.0572</td>
<td>2.3571</td>
</tr>
<tr>
<td>Time-range: 8 hours &amp; notice period: one week</td>
<td>0.0477</td>
<td>0.0588</td>
<td>0.8116</td>
</tr>
<tr>
<td>Time-range: 6 hours &amp; notice period: one day</td>
<td>-0.2749</td>
<td>0.0620</td>
<td>-4.4287</td>
</tr>
<tr>
<td>Time-range: 8 hours &amp; notice period: one day</td>
<td>-0.4940</td>
<td>0.0649</td>
<td>-7.6119</td>
</tr>
<tr>
<td>€ 75 (one-way, incl. taxes &amp; fees)</td>
<td>1.3201</td>
<td>0.0493</td>
<td>26.7503</td>
</tr>
<tr>
<td>€ 100 (one-way, incl. taxes &amp; fees)</td>
<td>0.6094</td>
<td>0.0494</td>
<td>12.3333</td>
</tr>
<tr>
<td>€ 125 (one-way, incl. taxes &amp; fees)</td>
<td>-0.4118</td>
<td>0.0594</td>
<td>-6.9242</td>
</tr>
<tr>
<td>€ 150 (one-way, incl. taxes &amp; fees)</td>
<td>-1.5177</td>
<td>0.0824</td>
<td>-18.4103</td>
</tr>
<tr>
<td>None462</td>
<td>-1.5560</td>
<td>0.1427</td>
<td>-10.8985</td>
</tr>
</tbody>
</table>

Table 31: Aggregate part-worth utilities (main effects)463

The main effects show very intuitive results, which – when it comes to the valuation of existing product features - are in line with other studies of airline passengers (cf. chapter 4.3.2). First of all, the analysis showed that consumers derive the highest utilities from non-stop flights (1.15). What has been interesting is the fact that the option “Direct flight

462 Overall the “none” option has only been selected in 2.65 % of all choice situations.
463 All effects, except for the valuation of the level “Time-range: 8 hours & notice period: one week” exhibit a t-ratio larger than +/- 1.96, which means that they are significant on a p < 0.05 level. With regard to the interpretation of the values it should be noted that utility values of an attribute are interval-scaled, which means for instance that a utility value of 0.8 is not twice as good as a utility value of 0.4. However, from a respondents perspective, the perceived utility increase by moving from 0.4 to 0.8 is equally large than the utility gain that follows an exchange of an attribute level with a utility of 0 to another level with 0.4. Furthermore one has to observe that each attributes utility values are scaled in order to have a sum value of zero. This also means that the utility values cannot be compared across attributes.
OR connection flight" (-0.48) was preferred to the attribute level “connection flight” (-0.67). This shows that the respondents realized that although the first option comes at the price of not knowing the flight type, they might in the end even be better off than with a connection flight, since the flexible option at least entails the chance of obtaining a non-stop flight.

Of particular interest with regard to the question of how various components that add uncertainty for the customer are valued, were the results from the second attribute. As expected, the respondents preferred a specific flight (0.58) to an unspecified flight (0.13 to -0.49), which lends support to hypothesis four.

| H4 | Consumers that have the choice between a specified flight and an unspecified flexible time-range flight prefer the specified flight. | ✓ |
| H5 | The earlier the flight assignment time (information about actual routing), the more likely is the selection of a flexible time-range ticket. | ✓ |

Finally consumers also revealed a preference, for shorter time-ranges, during which the actual transportation would take place. This effect appeared irrespective of the notice period, at which the flight times are communicated to the customer. As a result, hypothesis six can be accepted.

| H6 | The shorter the potential time-range, the more likely is the choice of a flexible time-range ticket. | ✓ |

5.3.7.3 Attribute importance values

While the utility values are telling us how various attribute levels are valued against each other, they do not take into consideration how important certain attributes are in the decision making process. Furthermore in case of strong divergences among individual customer preferences regarding a certain attribute level, an aggregate analysis might be misleading, since opposing valuations would be covered by a neutral mean value. Therefore in order to obtain the parameter importances, at first the individual utility functions of the respondents were calculated using the Hierarchical Bayes estimation method. The Hierarchical Bayes methods uses a twofold modeling approach, which at the higher level assumes a certain distribution (usually a multivariate normal distribution) of the individual utility functions across a vector of mean values, and then on the lower level uses a MNL to calculate individual utility parameters as a starting point. The individual utility values are then used to build the overall distribution. In a series of
iterations (so-called draws) the algorithm after that recalculates the individual parameters based on information drawn from the assumed overall distribution until a convergence of the values is achieved.\footnote{Backhaus / Erichson / Weiber (2010), p. 356ff; Orme (2000), p. 2f}

Based on the individual utility values the importance of various attributes was calculated (relative to each other). The values show the extent to which the overall utility is affected, if there is a change from the least to the most preferred option of a particular attribute.\footnote{The attribute importance is calculated by comparing the difference between the largest and the smallest part-worth value of a particular conjoint attribute against the sum of the absolute differences of all included attributes. For instance, the absolute difference between the part-worth value of a direct flight (1.15) and a connection flight (-0.67) would be 1.82, which corresponds to 30\% of the sum of the difference of all attributes.} Besides the overall levels, Table 32 also shows the differences between business and leisure travelers with regard to the importance of certain attributes.

<table>
<thead>
<tr>
<th>Attribute level</th>
<th>All CBC participants (n=250)</th>
<th>Leisure travelers (85% of the subsample)</th>
<th>Business travelers (15% of the subsample)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flight type</td>
<td>30%</td>
<td>29%</td>
<td>36%</td>
</tr>
<tr>
<td>Flight specification</td>
<td>20%</td>
<td>19%</td>
<td>26%</td>
</tr>
<tr>
<td>Price</td>
<td>50%</td>
<td>52%</td>
<td>38%</td>
</tr>
</tbody>
</table>

\textbf{Table 32: Attribute importances}\footnote{Since the importance values are ratio data, an absolute value of 50\% means that the price is more than twice as important in the decision process as the flight specification modalities.}

As seen in the table, the price is by far the most important criterion, followed by the flight type and the flight specification. However, even among the group of business travelers who accepted flexible tickets in their relevant sets and therefore were able to participate in the conjoint analysis exercise, the relative importance of the price is smaller than this is the case with leisure travelers. This means that business travelers are placing a larger emphasis on other attributes (i.e. they value a specified non-stop flight higher than the average respondent), even if this comes at a higher cost.

\subsection*{5.3.8 Market simulation based on individual utility functions}

Based on the individual utility values it is now possible to calculate the take-up rate of flexible time-range tickets as a function of the ticket parameters (time of information, given discount, etc.). In order to avoid the problems which could arise from using a probabilistic share of preference model to forecast consumer choices, the expected market shares were calculated by applying the ‘first choice’ method on the individual utility values.\footnote{Cf. Orme (2000), p. 6f. In probabilistic models, the prediction of which alternative an individual would choose is made based on probabilities derived from the aggregated utility scores. A major problem of this approach is the fact that new products ‘steal’ market shares proportionally from all existing alternatives. However, as the following ‘blue bus / red bus’ example illustrates this is not a realistic assumption. In this example, a blue bus competes against the car in the modal split and achieves a market share of 50\%. If now a red bus would also start operations on this route and would gain 33\% market share, these percentage points would be equally subtracted from all other alternatives, although it is more likely to assume that the gained passengers would mostly be blue bus passengers. This problem is also called the ‘blue bus / red bus’ problem.}

465 The attribute importance is calculated by comparing the difference between the largest and the smallest part-worth value of a particular conjoint attribute against the sum of the absolute differences of all included attributes. For instance, the absolute difference between the part-worth value of a direct flight (1.15) and a connection flight (-0.67) would be 1.82, which corresponds to 30\% of the sum of the difference of all attributes.
466 Since the importance values are ratio data, an absolute value of 50\% means that the price is more than twice as important in the decision process as the flight specification modalities.
467 Cf. Orme (2000), p. 6f. In probabilistic models, the prediction of which alternative an individual would choose is made based on probabilities derived from the aggregated utility scores. A major problem of this approach is the fact that new products ‘steal’ market shares proportionally from all existing alternatives. However, as the following ‘blue bus / red bus’ example illustrates this is not a realistic assumption. In this example, a blue bus competes against the car in the modal split and achieves a market share of 50\%. If now a red bus would also start operations on this route and would gain 33\% market share, these percentage points would be equally subtracted from all other alternatives, although it is more likely to assume that the gained passengers would mostly be blue bus passengers. This problem is also called the ‘blue bus / red bus’ problem.
During the conjoint exercise the respondents were also shown two fixed choice situations (i.e. exactly the same composition of attribute levels was shown to all respondents), which were not taken into consideration in the utility modeling process. Instead, these ‘holdout’ tasks were used to assess the goodness of fit of the model by comparing the expected market shares of the defined product types with the actual decisions by the respondents. As shown in Table 33 the model achieved a very good performance with an average deviation of only three percentage points.

<table>
<thead>
<tr>
<th>Holdout choice task 1</th>
<th>Option 1</th>
<th>Option 2</th>
<th>Option 3</th>
<th>Option 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Specified non-stop flight: €125</td>
<td>Flexible connection flight, notice: 1 week, time-range 6 hours. €75</td>
<td>Flexible connection flight, notice: 1 week, time-range 8 hours. €75</td>
<td>Flexible ticket (non-stop OR connection), notice: 1 week, time-range 8 hours. €150</td>
</tr>
<tr>
<td>Forecasted market share of alternative</td>
<td>54%</td>
<td>42%</td>
<td>3%</td>
<td>0%</td>
</tr>
<tr>
<td>Actual % of respondents</td>
<td>50%</td>
<td>41%</td>
<td>8%</td>
<td>1%</td>
</tr>
<tr>
<td>Deviation in %-points</td>
<td>4%</td>
<td>1%</td>
<td>5%</td>
<td>1%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Holdout choice task 2</th>
<th>Option 1</th>
<th>Option 2</th>
<th>Option 3</th>
<th>Option 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Flexible non-stop flight, notice: 1 week, time-range 6 hours. €75</td>
<td>Flexible connection flight, notice: 1 week, time-range 6 hours. €75</td>
<td>Flexible ticket (non-stop OR connection), notice: 1 week, time-range 8 hours. €150</td>
<td>Flexible non-stop flight, notice: 1 week, time-range 6 hours. €150</td>
</tr>
<tr>
<td>Forecasted share of alternative</td>
<td>94%</td>
<td>3%</td>
<td>0%</td>
<td>3%</td>
</tr>
<tr>
<td>Actual % of respondents</td>
<td>88%</td>
<td>5%</td>
<td>1%</td>
<td>4%</td>
</tr>
<tr>
<td>Deviation in %-points</td>
<td>6%</td>
<td>2%</td>
<td>1%</td>
<td>1%</td>
</tr>
</tbody>
</table>

Table 33: Evaluation of market-share model based on holdout tasks

In order to be able to estimate the market share that certain flexible products could achieve, at first the currently prevailing products have to be described in order to be used as reference points later on. A test conducted by the German “Stiftung Warentest” in 2009 found an average ticket price at the three major European network carriers of around €250 - €300 incl. taxes & fees for return tickets within Europe (Lufthansa: €249; British Airways: €265; Air France: €308). At the same time comparable flights with the leading LCC could be purchased for roughly €150 (Ryanair: €144; Easyjet: €166).

‘Independence from Irrelevant Alternatives’ (IIA). By using a ‘first choice’ model based on individual data, the IAA problem is eliminated, since new products (if they show a higher utility) directly take away market shares from the previously considered alternative (and not proportionally from all available alternatives).

With regard to the interpretation of the displayed market share values it has to be noted that only people who have accepted flexible tickets in their relevant set (77.5% of all respondents) have participated in the conjoint exercise.

Cf. Stiftung Warentest (2009), www.test.de; The data was based on selected routes from German airports to Berlin, Barcelona, London, Mallorca, Paris, Rome and Vienna, which constitute rather competitive routes and therefore might even understate the overall average price level on all European O&Ds. However,
Since consumers in most O&D markets nowadays already have the chance to choose between non-stop flights and connection flights, the latter are to be included as well in the market share scenarios. To compensate the consumers for the additional travel time and the inconvenience of changing planes, these tickets are usually sold at a lower price than non-stop flights (a Canadian study found an average discount of 15% in comparison to non-stop flights). In the scenarios connection flights are therefore always priced one price step below the non-stop flights. Based on this market data three scenarios were built which are presented in Table 34.

<table>
<thead>
<tr>
<th>Scenario name / Offered flights &amp; prices (one-way)</th>
<th>Very competitive route (incl. LCC)</th>
<th>Regular route</th>
<th>High-price route</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference products (specified flight times)</td>
<td>Non-Stop flight € 100</td>
<td>€ 125</td>
<td>€ 150</td>
</tr>
<tr>
<td></td>
<td>Connection flight € 75</td>
<td>€ 100</td>
<td>€ 125</td>
</tr>
<tr>
<td>Newly added product</td>
<td>Various types of flexible time-range tickets at different prices</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 34: Developed market scenarios

The aim of introducing several scenarios is to be able to estimate the acceptance of flexible time-range tickets, while they are offered next to a realistic set of already existing options. Furthermore, the variation of the price of competing products (as a function of the competition on a route), allows for an evaluation of the likelihood to select flexible products as a function of the relative discount to existing market alternatives.

5.3.8.1 Highly competitive route

In the first scenario, a highly competitive route is assumed, where the price of a non-stop flight does not surpass €100 and connection flights are even offered at a price of €75 (all prices are given for one-way flights). If a flexible product would be added to this market it would be able to be the first choice of up to 63% of all people, who have previously accepted flexible time-range tickets in their relevant set (depending on the product characteristics with regard to the degree of uncertainty involved). To obtain overall market shares, it has to be considered that 22.5% of all respondents in principle refused to consider flexible tickets as a possible alternative in their flight selection process. Therefore, if the overall market is considered, the attainable market share of flexible time-range tickets in a very competitive market situation ranges between 6 – 49%. As shown in Figure 79, in general, flexible tickets which guarantee the buyer a non-stop flight, are able to attract more passengers, than tickets which do not define whether the flight will be a direct or an indirect flight. Furthermore, in both categories tickets entailing a notice period of one week are preferred to those, where the customers are only informed of their precise flight times one day prior to departure. The lowest

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acceptance is achieved by tickets, which leave it open until one day prior to departure, at what time the passenger will depart either by non-stop or by indirect flight during a time-range of eight hours. However, even this ticket type, if offered at a price discount of 25% relative to specified non-stop flights (and at the same price of a fully specified connection flight) is able to gain an overall market share of 6%.

![Figure 79: Expected market share of flexible tickets (very competitive route scenario)](image)

### 5.3.8.2 Regular route

In the second scenario, a specified one-way flight was priced at €125 (which, if multiplied by two, corresponds almost exactly to the average price charged by Lufthansa on European routes for a return ticket). Furthermore the scenario included a connection flight for a price of €100. If flexible time-range tickets would be added at a price of €100 to this market, they would be able to achieve a market share between 10% (non-stop or connection flight, 8h time range, notice period 1 day) and 58% (non-stop flight guaranteed, 6h time range, notice period 1 week). If the price is lowered to €75, even more people (24%) would accept the least accepted flexible ticket. However, the share of people who accept the most preferred flexible ticket option even at the reduced price does not exceed 58%, which also shows that a certain fraction of travelers is not willing to compromise on a fixed schedule and cannot even be lured by lower prices (cf. Figure 80).

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471 Own illustration
472 Cf. Stiftung Warentest (2009), www.test.de
5.3.8.3 High-price route

Figure 81 shows the results of the market simulation in the high-yield scenario, where a one-way direct flight is offered at a price of €150. In order to be able to assess the impact of different price levels, in this scenario the flexible ticket options are offered at €125, €100 and even €75. In this environment the offered flexible tickets are able to gain market shares between 9% and 69%.

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473 Own illustration
Of particular interest though is the difference in the acceptance rate as a function of the given discount. If for instance the least attractive flexible ticket (which includes non-stop and connection flights during a time-range of eight hours in the relevant set with the actual assignment only being done one day prior to departure), one can see that there is a strong increase in the market share if the price is lowered from €125 to €100, with a proportionately seen inferior market share increase if the price is further decreased to €75. More specifically, a discount of 17% relative to a specified non-stop flight leads to a market share of 9%, a discount of 33% results in a market share of 35% and a discount of 50% in a market share of 42%. This allows for an acceptance of hypothesis seven, which states that the acceptance rate is following a logistical function. At low discount rates, only few people accept flexible time range tickets. However, after the inflection point additional discounts do not lead to a proportional gain in market shares.

| H7 | The likelihood to accept a flexible time-range tickets as a function of a given price reduction is not following a linear but rather a logistical function. Unless a certain minimum discount is granted customers are hardly considering flexible tickets as an alternative at all. There is a saturation point, after which the marginal increase in acceptance triggered by additional discounts decreases. |

**5.3.8.4 Usage of flexible time-range tickets for additional trips**

After having been confronted with the choice-based conjoint exercise the respondents were asked whether they would use flexible time-range tickets instead of existing tickets
or in order to make additional trips. In this context, 73% said that they could imagine undertaking even additional trips if the conditions of the ticket are appealing (Figure 82).

![Usage of flexible time-range tickets for additional trips](image)

Figure 82: Usage of flexible time-range tickets for additional trips

Although stated preference data concerning future behavior often tends to overestimate the actual consumption of a service\(^474\), one can, based on the huge proportion of respondents who say that they would use flexible tickets for additional trips conclude that these tickets are able to induce additional demand, which verifies hypothesis eight.

| H8 | Flexible time-range tickets can induce additional demand.
|----|---------------------------------------------------|

5.4 Discussion of results

As laid out in chapter 2.5.5, network airlines are under heavy pressure to find new yield management strategies, which allow them to counter the price pressure originating from LCC and their restriction-free pricing (RFP) models. The success of this model is also reflected in the prevailing study: 51% of all trips made by leisure travelers were made using LCC. In this context, network airlines are looking for new products, which allow them to target the low-cost segment, without having to cannibalize existing revenues, as it is the case with pure (unconditional) price discounts.\(^475\)

While in chapter 4 flexible time-range tickets were presented as one possible answer to the faced yield management challenge, the preceding sections of chapter 5 examined different design options and their acceptance by potential customers during an empirical study. In the following, the the suitability of flexible time-range tickets for the pursued

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\(^{475}\) Garrow (2009), p. 252
aim will be discussed in order to come up with concrete proposals for an optimal use of the presented ticket concept.

5.4.1 The suitability of flexible tickets to address price sensitive travelers without cannibalizing existing revenues

As shown in the empirical study, business travelers (18% of all travelers) are responsible for 41% of all flights. Moreover, they are of high importance to airlines since they usually book at a later point in time and are less price sensitive, thereby contributing more than proportionally to the overall yield of a flight. As a result, in order to qualify as a viable solution that is able to properly address the presented yield challenge faced by network airlines, flexible tickets would not only have to be highly attractive to low-cost travelers, but should at the same time also disqualify for business travelers, so as to avoid that passengers who previously purchased high-yield tickets switch to newer, cheaper products (product cannibalization). As explained in the following, based on the empirical study, both conditions are fulfilled.

First, the attractiveness for low-cost travelers will be examined. Leisure travelers in general and passengers who mostly use LCC in particular, clearly rated the price as the by far most important criterion when it comes to selecting a flight. In exchange for a low price, passengers are willing to make sacrifices concerning the duration of the trip or the presence of connections. Furthermore, especially low-cost travelers (82% of this group) also stated that they are indifferent regarding the actual carrier which is operating a flight, thereby exhibiting a very low brand loyalty. When asked about the types of flight which would be considered for an intra-European flight, almost one third of all passengers stated connection flights as one option, with 18% also considering using a LCC which serves an airport that is one hour further away than their nearest airport. Within the latter group, which is obviously willing to exchange travel time against cheaper fares, 63% were also considering connection flights with network airlines. These findings confirm that there is a highly price-sensitive low-cost customer segment which is willing to fly with any airline even if it takes longer than direct flights as long as the price is competitive. To the contrary, business travelers rated the convenience of the schedule the highest and also exhibited a higher loyalty to network airlines. As a result it was expected that this group would also be more reluctant to use flexible time-range tickets.

As depicted in Figure 75, 82% of all asked leisure travelers said that they could definitively (55%) or maybe (27%) imagine using flexible time range tickets. On the other hand, the majority of business travelers (44%) were clearly ruling out the use of flexible time-range tickets, with only 30% selecting 'maybe' and the remaining 27% opting for 'yes'.

Even among those business travelers who generally accepted flexible tickets in their relevant set (and therefore participated in the conjoint study), at the attribute level the

476 Cf. Diller / Köhler (2008), p. 357ff
price was deemed less important than both the flight type (direct flight) and the specification (higher reluctance to select options where the flight times are not specified). This supports the hypothesis that flexible time-range tickets, while being highly attractive to leisure travelers are no suitable option for most business trips, thereby avoiding large-scale cannibalization of revenues.477

5.4.2 The business case of flexible tickets

In order to be able to maximize the revenues of a particular flight, an airline relies on accurate demand forecasts. In particular on busy flights, the yield management of an airline has at some point to decide, whether it wants to limit the sale of low-fare tickets in order to preserve capacity for late-booking high-yield business passengers. As illustrated in Figure 83, which is based on booking data of a Swiss International airlines flight, more than 30% of all bookings are accepted in the last week prior to departure.

![Figure 83: Distribution of bookings and revenues (last 75 days prior to departure)](image)

What is more, due to the prevailing yield management practices, which strongly use the advance booking period as a means of price discrimination, the bookings of the last week even account for 40% of the revenue of the displayed flight. The monetary

477 Having hotels in mind which are also sold by Priceline, Hotwire or other ‘opaque’ channels, several authors argue, though, that introducing low-priced products which in the end are of similar quality than a specified product will in the long run also have a negative impact on the price level of the specified product (cf. Fay (2008), p. 58f). However, since airline tickets involve more potential uncertainty (duration, departure & arrival times, involved carrier) than hotels (location, hotel chain) this argument seems less convincing in the airline industry.

478 Cf. Eggermond / Schuessler / Axhausen (2007), p. 10. The booking data is taken from a Swiss International Airlines flight from November 2006. As a result of the selected month, it is likely to assume the proportion of early-booking leisure passengers is slightly underrepresented. The price data, which has been required to calculate the cumulated revenue of the flight, is based on the (approximated) values for Lufthansa as quoted in Stiftung Warentest (2009), p. 74ff. This is also in line with the data analyzed by Varedi (2010, p. 10). Looking at 22,900 flights of a North-American airline, he found that the average number of seat sold increases as the departure date is approaching (in spite of the fact that the flights are also priced higher, when booked at a later time).
importance of late bookers also became apparent in an analysis of fares between Amsterdam and London in spring 2009, which found that “average fares increase by about 3% each day as departure approaches, with a cumulative 80% increase in the last 20 days.”

Given the monetary importance of late bookings, it is not astonishing that airlines are willing to reject low-yield bookings (which usually are placed several weeks earlier) by limiting the amount available low-fare tickets in order to preserve capacity for an expected business demand. However, if the forecast for a high-yield booking class turns out to be too high, which given typical forecast errors (on the booking class level) of up to 25% in the airline business is often the case, this passenger ‘spill’ results in unused capacity (‘spoilage’) and lost revenues. In this context, flexible time-range tickets would allow airlines to accept more low-fare booking requests than in the current environment by pooling the demand risk of several flights (it is unlikely that the amount of forecasted late-bookings materializes on all flights).

To avoid accepting more bookings than the overall set of flights which are composing a flexible ticket is able to accommodate, airlines could use a fractional booking approach. This means that if a flexible booking is accepted which builds upon a set of five flights, the booking could be considered as 0.2 passengers in each of the flights booking records. If one of the flights reaches its capacity limit (based on the forecasted bookings corrected for the expected no-shows), the flight is withdrawn from the flexible product set and the fractional booking in the remaining four flights is increased to 0.25 passengers. Once four flights out of the potential flight set are fully booked, the flexible ticket would be switched into a full (1.0) booking on the last remaining flight.

If several flights still have available seats at the defined notification time (e.g. one week prior to departure), the airline could assign the booking to the alternative in the flexible-ticket set which entails the lowest marginal costs, i.e. mainly costs for the additional fuel burn resulting from another passenger, passenger-specific airport fees and catering costs (if applicable). Ceteris paribus (e.g. assuming the same type of aircraft) this would usually imply to assign passengers to a non-stop flight, since these flights minimize the distance flown and avoid the costs of a transfer and an additional flight. From a Yield Management perspective the flight with the lowest bid-price (i.e. the lowest opportunity costs) should be selected.

By pooling the risk that more passengers arrive than there is capacity for in all flights of the flexible time-range ticket set and by shortening the forecast horizon (i.e. the time between flight allocation and departure date) as a consequence of the delayed assignment, airlines are able to increase the amount of low-fare tickets sold and the

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481 Cf. also Petrick et al. (2010) for a detailed discussion of various allocation mechanisms
degree of overbooking which they currently practice. The resulting impact on the revenues of a flight with a high load factor is displayed in Figure 84.

![Figure 84: Impact of flexible time range tickets on optimal overbooking rate](image)

In conclusion, flexible time-range tickets are able to generate a positive contribution, if the following conditions are given on a route:

- Substantial demand by low-yield passengers which cannot be profitably satisfied by traditional offerings of a network carrier
  - because the presence of LCC on the route led to an average price level which cannot (in the long run) be met by offering traditional, specified tickets with a network airline cost structure
  - and because the absence of effective rate fences makes it impossible to offer an acceptable amount of low-fare tickets without having to accept a cannibalization of former high-yield revenues.
- Relatively high demand uncertainty on the level of individual flights, which becomes lower, the more the departure date approaches
- There are several routing alternatives between origin and destination which are under the commercial control of one airline group.
• At least some flights on the considered route are sometimes subject to a load factor of 100% (otherwise, there is no need to further optimize the available capacity usage).\textsuperscript{482}

A study by Petrick et al. (2010) used OR-techniques to quantify the revenue gains which can be achieved through a delayed assignment of booking requests. They assumed a flexible product which incorporates both non-stop and indirect flights and is sold at a discount of 25% relative to the lowest specified fare. Based on their simulation they came to the conclusion that the gained flexibility in average allows for an increase of revenues by 4%. Furthermore, in line with what has been found above, they specify that “flexibility is more important to the firm if uncertainty is higher and that a late notification date helps to further increase revenues”.\textsuperscript{483}

5.4.3 Recommended use of flexible time-range tickets

The preceding analysis examined the acceptance of flexible products on Intra-European flights with a length of three flight hours. This setting has been chosen since the qualitative pre-study revealed that on shorter routes, the potential inclusion of a connection flight in the flexible product set would lead to a disproportionate prolongation of the overall travel time in comparison to a direct flight. Based on these preferences, it would be advisable to exclude connection flights from the set of potential flights that form a flexible time-range ticket on short O&Ds which are also served by non-stop flights. Irrespective of the route lengths, the simulation results also point out that the largest possibility airlines have to increase the acceptance of flexible time-range tickets is to limit the potential flights to non-stop flights. Thereby, on short routes flexible products could be used on all O&Ds where an airline group offers several flights a day.

When it comes to less traveled O&Ds, passengers are often used to transferring flights in order to reach their final destination. As a result, passengers usually can chose from several transfer hubs and - due to this strong competition - the importance of the price increases: “Often the price elasticity of demand is higher for travel in through markets than in point-to-point markets to or from hubs.”\textsuperscript{484} While single airlines usually do not offer enough connections in an acceptable time-range in order to market them as flexible products, airline groups together usually provide enough connection flights to offer time-range tickets as a cheap option for through markets (cf. for instance the offer of nine daily Lufthansa or partner airlines flights with not more than one connection between Bucharest and Gothenburg as shown in Table 2).

Besides selecting routes which qualify for the offer of flexible products, it also has to be decided, whether this kind of ticket should be constantly offered, or whether the offer should be temporarily limited. As pointed out before, flexible products can on the one

\textsuperscript{482} Even on low demand flights, flexible products can be beneficial, since the degradation of the product allows the airline to offer lower prices which are able to induce additional demand (cf. also Gallego et al. (2004), p. 36) without lowering the reference price level of regular tickets (cf. Diller / Jöhler (2008), p. 357ff).

\textsuperscript{483} Petrick et al. (2009), p. 22

\textsuperscript{484} Hanlon (2007), p. 118
hand serve as a means to induce additional demand, and on the other hand support a more balanced usage of capacity by shifting passengers from flights with high demand to flights with low demand. If an airline primarily wants to induce additional demand (without eroding the price of its specified product) it could use flexible products during all times. However, if the main aim is to achieve a more balanced demand allocation, flexible time-range tickets are only reasonable if at least one of the flights in the product set is sometimes subject to more demand than there is capacity for (which translates into a load factor of 100%).

Given the sensitive nature of load factor data in a competitive environment it is not surprising that airlines in general only publish aggregated load factor data. In 2007 the airlines of the Association of European Airlines published a load factor of 70% on European routes and approximately 80% on long-haul routes.\textsuperscript{485} However, given the strong variances in demand between seasons, weekdays and even time periods during the day (cf. chapter 2.5.3), it is obvious that in order to reach an average load factor of 70%, many flights have to be operated close to full capacity. Wensveen (2007) for instance presents the empirical example of a Boeing 757 routing during two days in summer. In total, the aircraft has been flying 15 flight legs on these days and reached an average load factor of 60%. However, this average is composed of eight flights which had a load factor of more than 75% (at least one of these flights was even so heavily overbooked that the airline had to turn some passengers away), three flights which had a load factor around 50% and four flights that experienced load factors between 15-45%.\textsuperscript{486}

On a broader scale, Malighetti et al. (2009) examined all flights of the leading LCC Ryanair from July 2005 until June 2006 in order to find out how often a flight is fully booked. They concluded that around 15% of all flights are fully booked (cf. also Figure 85).\textsuperscript{487}

\textsuperscript{485} Cf. AEA (2007), p. 5 & 15
\textsuperscript{486} Cf. Wensveen (2007), p. 192
\textsuperscript{487} Cf. Malighetti / Paleari / Redondi (2009), p. 201
Figure 85: Number of Ryanair routes with a certain percentage of fully-booked flights

Since passengers usually book return tickets, the (mathematical) chance that at least one of the flights is fully booked is 28%. If the passenger is travelling on a through-hub connection which consists of four flight legs, the probability of encountering at least one flight that is fully booked even increases to 48%. This shows that while of course flexible time-range tickets are most appropriate during peak-demand periods, the cumulated probability of touching such a period in the course of a return flight booking (especially on through hub O&Ds) would also support a continuous offer of such tickets.

When it comes to the actual design of the flexible product, the empirical study showed a clear preference for tickets which do not entail the possibility of connection flights in the relevant set (this reflects a preference for shorter travel times as well as an averseness to transfers). With regard to the other characteristics of flexibility, the length of the announced travel time-range proved to be not very important to the respondents. This allows airlines to build flexible time-range tickets by combining several potential flights even if their departure times are not close to each other. The notification time, to the contrary, proved to be of high importance to potential buyers of flexible tickets. As a result airlines have to outweigh the benefits of a longer notification period, which results in a higher demand for the ticket, with the benefits from a delayed flight allocation (better capacity utilization) on a per flight basis. If the forecast accuracy on a particular route (or even a particular flight) is traditionally high, the airline could use flexible time-range

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\(^{488}\) Cf. Malighetti / Paleari / Redondi (2009), p. 201. The authors used an automated crawler to extract booking information of all flights during the period of one year. A flight was considered fully booked if it was not possible to book this flight via the website of the airline. Since the chart does not contain any information about the flight frequency on these routes it is not possible to calculate a weighted overall average.
tickets with a relatively long notice period (e.g. one week) as a means to induce additional demand without having to compromise the overall fare level. In case of a rather poor forecast quality, a short notice period (e.g. one day) should be selected, since this allows shifting flexible bookings in order to fill seats which contrary to expectations are still available shortly before departure.
6 Summary

6.1 Summary and conclusions

The airline industry has seen considerable growth during the last 60 years. In the recent past, the liberalization of air traffic in the European Union has even promoted this growth. In particular, the market entry of Low Cost Carriers (LCC), which provided simplified products (point-to-point traffic) at lower fares than traditional network airlines, has tapped new passenger potentials and led to an average yearly passenger growth of more than 5% from 2000 to 2008.\textsuperscript{489} With regard to market shares, this growth has been detrimental to network airlines, which were not able to match the prices of their new competitors particularly at the intra-European level. Therefore, many airlines of this group lost market shares. In average, the revenues from intra-European traffic covered only 98% of the costs, thereby making it the least attractive segment for European network airlines.

The reasons for this mismatch can be found on the cost, as well as on the revenue side. First of all, in a hub-and-spoke network, airlines focus on filling their long-haul flights by means of short-haul feeder flights with the aim of maximizing the overall network revenues. Often, this also implies offering flights which, if analyzed on an individual level, are not profitable in order to sustain a sufficient flow of passengers into the long-haul network. Furthermore, many of the cost advantages of LCCs are not accessible to network airlines due to their transfer-oriented production network on the hub. One disadvantage that network airlines face is having to keep some airplanes longer on the ground at the hub than technically needed, in order to allow passengers of other incoming flights to transfer onto the next outgoing flight. The amount of hours that an airplane can actually spend in the air is therefore significantly limited (an area, where LCCs achieve significantly better values and therefore lower unit costs). This difference is even amplified by the fact that a wave structure of departures and arrivals at a hub leads to temporal congestion and costly delays. Finally, the operation of a diverse fleet of short-haul (feeder) and long-haul aircrafts reduces the ability to profit from economies of scale which occur in the harmonized aircraft fleets of LCCs.

On the revenue side, the introduction of restriction-free one-way pricing schemes by LCCs has also strongly lowered the acceptance of price discrimination by means of traditional rate fences (e.g. minimum stay requirements). Network airline customers are less willing to accept these practices, which forced network airlines to reduce the degree of applied price discrimination. Current yield management approaches are mainly focusing on the booking date in order to distinguish between passengers with low or high willingness to pay. As a result of the increased competition, network airlines were confronted with a decline in yields by 15% from 2001 until 2007. In a situation of rising costs (especially fuel costs) and falling revenues, many small network carriers were

\textsuperscript{489} Cf. Eurostat (2009), http://epp.eurostat.ec.europa.eu
forced to cut routes, which decreased their overall network size and in turn also their ability to compete with larger airlines on long-haul routes. The consequence was a large consolidation wave among European airlines, which led to the formation of three dominant network airline groups (with Lufthansa, Air France-KLM and British Airways as the dominant firms respectively). A by-product of these mergers was the appearance of partly overlapping multi-hub networks. From a network perspective, this development gives room to new marketable connections in through-hub markets under the control of a single company (e.g. a passenger could use a morning flight from A to C via Hub 1 and return with an afternoon flight from C to A via Hub 2).

The redundant connection between origin-destination pairs, however, also offers new opportunities for yield management practices. Currently airlines have to decide on a flight-per-flight basis based on forecasted demand of late-booking high-yield passengers (mostly traveling on business purposes) whether they should restrict the sale of low-yield early bird specials in order to preserve capacity. In order to decrease this dependency (on usually highly erroneous forecasts), airlines could bundle redundant connections as flexible time-range ticket sets, which guarantee transportation from A to B within a defined time window at a guaranteed cost, without specifying the precise flight times at the moment of purchase. These tickets build upon the concept of demand risk pooling, which lowers the variance of forecast errors by grouping several similar products. Given the fact that on average 30% of the available capacity on intra-European flights carried out by network carriers is unused, these tickets could also be used as a means to induce additional low-yield demand in order to raise the load factor without cannibalizing existing revenues.

An analysis of existing flexible products revealed that they either lack a broad customer acceptance by hiding the destination point during the booking process, which strongly limits the potential target group); or, by assigning passengers to a specific flight directly after the payment process, lose out on the potential to increase the load factor by assigning passengers to flights with an unexpectedly low number of passengers at a later point in time (i.e. after most of the actual demand for a particular flight has been revealed).

This dissertation, therefore, includes an empirical survey to elaborate on how uncertainty would be valued if destination details were available at the moment of purchase, but not the precise routing and the exact travel times (within a defined time window). Based on the findings of an explorative study, a quantitative main study was undertaken in January 2011, which initially included 553 Austrians, who were older than 18 and were invited to participate in a screening process based on age, gender and education. Out of this initial group, 356 participants passed the screening process (which limited the participation to respondents who were flying at least once during the last year) and completed the survey.

\[490\) Cf. AEA (2007), p. 5 & 15
Besides confirming the importance of the price when it comes to selecting a flight, the survey also revealed that 70% of all travelers are indifferent with regard to the operating carrier when selecting an intra-European flight. When asked to rate the importance of several characteristics of a flight, there has also been a clear distinction between business and leisure travelers. While the former considered the convenience of the flight type (non-stop or connection) as the most important criterion, leisure travelers ranked the price first. This fosters the assumption that flexible time-range tickets, which exclude the flight type and the flight times, can serve as a vital mean to address price-sensitive travelers without risking a downward shift in business traveler revenues.

This hypothesis was also confirmed in the direct question, whether or not passengers could imagine using flexible time-range tickets: while 82% of all leisure travelers stated that they could maybe (27%) or even definitively (55%) can imagine the use of these tickets, the corresponding acceptance rate of business travelers (of which 26.5% answered ‘yes’ and 29.5% selected ‘maybe’) was significantly lower.

In the subsequent choice based conjoint exercise, various product features of potential flexible time-range tickets were examined. The results indicate that there is a large willingness to pay for non-stop flights. This dampens the attractiveness of flexible tickets because they eventually (based on their design) include connection flights in the potential flight set. With regard to the notification period, a clear preference for a notification at least one week prior to departure was shown. The length of the time-window in which the transportation is guaranteed (i.e., six or eight hours) turned out to be of lower importance to the respondents.

Based on a Hierarchical Bayes estimation of individual utility functions of the respondents, a market share simulation was performed, which compared different flexible time-range products (i.e., at varying prices, notice periods and time window lengths) to specified non-stop or connection flights. The results indicate that even in competitive markets, flexible tickets can achieve market shares between 6 - 49% when sold at a discount of 25% relative to specified non-stop flights. If the incurred uncertainty is lower (i.e. for instance: only non-stop flights are included in the set of potential flights, the customer is informed already one week prior to departure and the potential time-window entails only six hours), then the acceptance rate by customers is higher. The study also shows that the likelihood in accepting a time-range ticket as a function of the given discount does not follow a linear but rather a logistical function; thus, many respondents are only willing to accept the comprised uncertainty if they are able to make a substantial bargain.

In conclusion, flexible time-range tickets were found to be a suitable mean to attract the low-fare market without significantly cannibalizing existing revenues. Given their high acceptance rate, the addressable target segment appears to be large enough to justify investments in IT infrastructure and marketing, which are necessary to introduce such a product. By pooling the demand risk across several flights through the use of flexible time-range tickets, network airlines can increase marketable capacity and attainable load factor and thereby use their redundancy in multi-hub networks as a strategic asset against their LCC competitors.
6.2 Limitations of the study and further research areas

The presented empirical results are built upon an online-survey among the members of an online access panel. As a result, travelers without access to the internet were systematically excluded from participating in the survey. However, given the large overlaps between the populations of internet users and airline travelers (see also chapter 5.3.1) and the strongly increasing role of the internet as a sales channel for internet tickets, this downside of the chosen survey mode was nonetheless deemed acceptable.

With regard to the results of the market share simulation (cf. chapter 5.3.8), it must be stated that the obtained market shares are assuming a stable price of competing products. In reality, however, flights are subject to various price changes as a consequence of the yield management practices of an airline. Therefore, the obtained results should be considered as an approximation, which mainly express how many respondents would select a particular flexible product, that is, if it were offered next to the specified alternatives. In order to gain a more realistic estimate for a particular route, practitioners should use a combination of the three scenarios according to the competitive situation at various booking times.

Finally, the external validity of choice-based conjoint studies without real purchase obligation has often been challenged. In their meta-study, Backhaus and Broszka (2004) come to the conclusion that there is a tendency to overestimate the willingness to pay for certain services in Stated Preference surveys. However, since it is not possible to observe the revealed preferences for currently non-existent products, this limitation had to be accepted. As a consequence, the overall acceptance for flexible products might in reality turn out to be lower than in the presented market share simulation.\(^{491}\) Given the calculated acceptance levels of up to 60% of all travelers (i.e. depending on the selected product features), this limitation does not affect the main finding of the study, though, namely that there is a large segment of the market for which flexible time-range tickets are a vital travel option. Furthermore, this does not influence the relative valuations of the tested product alternatives.

Although this paper focused on intra-European flights, the concept of flexible time-range tickets could also be extended to other flight lengths or other modes of transport. Furthermore, future research could also, based on the identified acceptance rates of various features of uncertainty (notice period, possible flight types and length of the travel time-window) model the benefits of flexibility from the perspective of the airline together with the achievable sales in order to narrow down under which circumstances a particular product design should be adopted in order to maximize revenues.

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**Expert interviews**


Oswald (2009): Interview with Mr. Martin Oswald, Head of Revenue Management at Austrian Airlines, Austrian Airlines Headquarter, Vienna, Oct. 21, 2009
Appendix 1: Qualitative interview structure guideline

Questions about the travel sector:
- Have you ever booked a journey without knowing important details before you left? For example when you were leaving, where you were going, or where you were going to stay. Give examples.
- How often do you fly on average per year? What is the main purpose of your flights?
- Do you normally book flights on your own? How do you book flights? Are you familiar with the booking processes? Do you think you have good knowledge of the structure of the different offers?

What is your most important criterion when purchasing flight tickets? For example price, reputation of the airline, departure/arrival time, stopover times.

Presentation of flexible time-range tickets:
At the moment airlines are thinking about the introduction of a new ticket type which is a bit (~10%-20%) cheaper than current discount prices. When you buy a ticket, the airline informs you about when you have to be at the airport and when you will arrive at your destination at the latest. However, you are not told which exact flight you will be assigned to.

For example, if you buy a ticket from Vienna to Lisbon two months prior to departure, you will be told to be at the airport check-in at 8 a.m. at the latest and the airline promises you an arrival time no later than 3 p.m. This is about two hours later than in a predetermined connection with one change of planes. Only a short time prior to the day of departure, the airline assigns you to a flight within the given timeframe. It can either be a direct flight, if there are seats available, or a connecting flight, meaning the transfer from one airplane to another via one of the airline’s hub airports (e.g. Munich, Frankfurt or Zurich). If there are available seats on the direct flight, you might even be in Lisbon much earlier. In any case, you will arrive no later than the promised time unless there are unexpected flight delays.

Questions about flexible time-range tickets:
- What are the first thoughts that come to your mind when you hear about the concept?
- What do you want to know to consider buying flexible time-range tickets?
- Depending on the design of the ticket, would you be willing to buy it? If yes, why? If no, what are your fears? How do you judge this ticket in comparison to a direct flight or a connection flight?
- What information do you want to receive when you book the ticket?
- Do you want to know the possible routings in the set of alternatives of the flexible ticket that you buy?
• When would you like to be informed about your actual routing at the latest? For example one week before the flight, one day before the flight or at check-in? Why is it important for you to know it at the mentioned point of time?
• How would you like to be informed about your actual routing?

Questions about the interviewees:
• How old are you?
• What is your occupation?
• What is your annual travel budget?
Appendix 2: Empirical survey questionnaire

Passagierbefragung der Wirtschaftsuniversität Wien

Sehr geehrte Damen und Herren,

im Zuge eines Forschungsprojektes der Wirtschaftsuniversität Wien wird aktuell ein völlig neues Vorhaben im Luftverkehr analysiert. Aus diesem Grund möchten wir Sie einladen, an unserer Befragung teilzunehmen. Die Umfrage dauert nur ca. 5 Minuten.

Vielen Dank für Ihre Unterstützung.

Prof. Dr. Sebastian Kunmer  Felix Badura
Vorstand des Instituts für Transportwirtschaft der WU-Wien  Dozent an dem Institut für Transportwirtschaft der WU-Wien

Zu Beginn würden wir gerne mehr über Sie und Ihre Reisegewohnheiten erfahren.

Wie alt sind Sie?

Bitte geben Sie Ihr Gesäßkennzahl an!

- männlich
- weiblich

Was ist Ihre letzte abgeschlossene Schulbildung?

Wie oft sind Sie insgesamt im letzten Jahr mit dem Flugzeug geflogen?

Flugreisen (Hin- und Retourflug gelten als eine Flugreise)

Oft hat man die Wahl zwischen klassischen Fluggesellschaften (z.B. Austrian Airlines, Lufthansa, Air France,...) oder so genannten Billigfluglinien (z.B. FlyNiki, AirBerlin, Germanwings oder Ryanair).

Wie viele Ihrer Flugreisen haben Sie letztes Jahr mit solchen Billigfluglinien gemacht (Hin- und Retourflug gelten als ein Flug)?

meiner Flugreisen wurden mit Billigfluglinien gemacht

Buchen Sie Ihre Flugtickets meist selbst oder erledigt das jemand anderer für Sie?

- meistens selbst
- meistens jemand anderes
If the respondent usually books flight by him / herself:

If booking is done by someone else:

---

All respondents
For all following questions, the travel purpose has been inserted based on the previous answer:

1. Wie lange vor Flugantritt buchen Sie bei privaten Reisen in der Regel Ihr Flugticket?
   - in der letzten Woche vor dem Abflug
   - zwischen einer Woche und einem Monat vor Abflug
   - zwischen einem Monat und drei Monaten vor Abflug
   - mehr als drei Monate vor Abflug
   - weiß nicht / keine Angabe

2. Stellen Sie sich vor, Sie müssen demnächst privat reisen. Bitte beurteilen Sie anhand der Skala, wie wichtig Ihnen diese Eigenschaften bei der Wahl eines Fluges sind.

<table>
<thead>
<tr>
<th>Ist mir sehr wichtig</th>
<th>Ist mir überhaupt nicht wichtig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gut passende Abflugzeit</td>
<td></td>
</tr>
<tr>
<td>Günstiger Preis</td>
<td></td>
</tr>
<tr>
<td>Direktflug (ohne Umsteigen)</td>
<td></td>
</tr>
<tr>
<td>Guter Sitzkomfort (beifreiheitlich)</td>
<td></td>
</tr>
<tr>
<td>Kostenlosen Essen an Bord</td>
<td></td>
</tr>
<tr>
<td>Dass die Airline mehrere Abflüge pro Tag zu meiner Destination anbiitet</td>
<td></td>
</tr>
<tr>
<td>Dass ich Meilen für mein Vielfliegerprogramm sammeln kann</td>
<td></td>
</tr>
<tr>
<td>Dass ich mein Ticket ggf. problemlos und kostenlos umbuchen kann</td>
<td></td>
</tr>
</tbody>
</table>

3. Welche Arten von Flugverbindungen kommen für Sie bei der Auswahl einer Flugverbindung für eine private Reise grundsätzlich in Frage?
   - Direktflug mit einer klassischen Airline (z.B. Austrian Airlines, Lufthansa, etc.) vom nächstgelegenen Flughafen.
   - Umsteigeverbindung mit einer klassischen Airline (z.B. Austrian Airlines, Lufthansa, etc.) vom nächstgelegenen Flughafen.
   - Direktflug mit einer Billigfluglinie (z.B. FlyNiki, AirBerlin, Germanwings) die vom nächstgelegenen Flughafen abfliegt.
   - Direktflug mit einer Billigfluglinie (z.B. Ryanair) die von einem kleinen Regionalflughafen abfliegt, der ca. eine Stunde weiter als der nächstgelegene Flughafen entfernt ist.

4. Ist es für Sie bei privaten Reisen wichtig, mit einer bestimmten Fluglinie zu fliegen?
   - Ja, vor allem aus Gründen der Flugsicherheit möchte ich nur mit bestimmten Fluglinien unterwegs sein.
   - Ja, da ich auf eine hohe Servicequalität Wert lege möchte ich nur mit bestimmten Fluglinien unterwegs sein.
   - Ja, ich achte darauf, nur mit Fluglinien zu fliegen, bei denen ich meilen sammeln kann.
   - Nein, solange es sich dabei um eine bekannte, europäische Fluglinie handelt ist es mir egal, mit welcher Fluglinie ich unterwegs bin.
   - Nein, solange die Rahmenbedingungen des Fluges und des Tickets (z.B. Abflugzeit und Preis) passen ist es mir völlig egal, mit welcher Fluglinie ich unterwegs bin.
In case of answer “no”:

Warum käme ein Ticket, bei dem die genauen Flugzeiten zum Zeitpunkt der Buchung noch nicht feststehen für Sie nicht in Frage? Bitte wählen Sie alle Aussagen aus, die auf Sie zutreffen.

- Ich muss bereits bei der Buchung meine genaue Ankunftszeit kennen da ich in der Regel abgeholt werde.
- Ich mag es generell nicht, wenn die Flüge nicht fix geplant sind.
- Sonstige (bitte eintragen):

In case of answer “yes” or “maybe”:

Stellen Sie sich vor, Sie müssen den nächst unbedingt privat in eine ca. 2-3 Flugstunden von Ihrem Wohnort entfernte Stadt (Bonn) verreisen und suchen für Ihre Reise nach einem geeigneten Flug.

Auf der nächsten Seite werden Ihnen die vier Flugtickets angezeigt, die nach Ihrer Recherche auf Basis ihrer gewünschten Abflughour den Hinflug am ehesten in Frage kommen.

Neben herkömmlichen Tickets bei denen schon bei der Buchung alle Fluginformationen feststehnen, sehen Sie dabei auch flexible Tickets, bei denen zwar der Reisetermin, die Art der Flugverbindung (z.B. Direktflug oder Umsteigeverbindung) und der Preis feststehen, die genauen Flugzeiten jedoch erst später bekannt werden.

Alle Flüge werden durch eine sichere und renommierte Airline (z.B. Austrian Airlines oder Lufthansa) durchgeführt und beinhalten jeweils das gleiche Serviceangebot.

Bitte wählen Sie das Angebot aus, das Sie am ehesten kaufen würden. Es ist dabei wichtig, dass Sie genauso entscheiden, wie es auch in Wirklichkeit tun!
If the respondents clicked on "examples", the following illustration was shown:

Choice based conjoint decisions (only visible for respondents who did not exclude flexible time-range tickets from their relevant set). In total, 10 situations were shown.
Stellen Sie sich bitte vor, Sie müssen nun für eine weitere private Reise in eine ca. 3 Flugstunde von Ihrem Wohnort entfernte Stadt (Versuchsstadt) einen Flug buchen. Hier gibt es die folgenden Reisemöglichkeiten.

Bitte wählen Sie das Angebot aus, das Sie am ehesten kaufen würden. Entscheiden Sie dabei vollkommen unabhängig von der letzten Auswahl.

Im Rahmen der vorher gezeigten Flugoptionen hatten Sie oft auch die Möglichkeit ein Ticket auszuwählen, bei dem die Flugzeiten bei der Buchung noch nicht feststehen.

Würden Sie so ein flexibles Zeitfensterticket eher nutzen um zusätzliche Reiser zu machen, oder würden Sie es einfach an Stelle der bisher genutzten Tickets verwenden?

- Ich würde es nur an Stelle der bisher genutzten Tickets verwenden
- Sowohl als auch
- Wenn der Preis stimmt könnte ich mir vorstellen mit so einem Ticket auch mehr Reisen als bisher zu machen
- weiß nicht / keine Angabe

All respondents

Welcher der folgenden Flughäfen liegt von Ihrem Hauptwohnsitz gesehen am nächsten?

Und welcher der folgenden Flughäfen liegt von Ihrem Hauptwohnsitz gesehen am zweitnächsten?

Abschließend würden wir auch noch gerne wissen, welcher beruflichen Beschäftigung Sie derzeit hauptsächlich nachgehen?

Vielen Dank für Ihre Teilnahme an der Umfrage!