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Network-legacy airline business model developments in the post-COVID European market

Abstract

The deregulation of passenger air transport was the first major trigger of changes in airline business models. For more than two decades now the hybridization of the two major business models in aviation (network legacy airlines and low-cost carriers) has been observed but the COVID-19 pandemic seems to have a strong catalytic effect in the ongoing process.

The paper focuses on the developments of airline business models in the wake of the turbulence induced by the COVID-19 pandemic. The focus is on identifying market shifts that happened since 2020 that led to airlines seeking new opportunities to gain competitive advantage. Moreover, the authors aim at identifying how network-legacy carriers adjust their business models to catch up with their low-cost counterparts in terms of traffic recovery and growth.

Following the COVID-19 pandemic, network-legacy carriers (NLCs) were disadvantaged compared to low-cost carriers (LCCs). In response, NLCs further hybridized their business models, including targeting leisure and VFR markets to a larger extent. However, this strategy is not fully aligned with operational aspects of NLCs' business model. As a result, this shift may be temporary.

Keywords: airline business models, competitive advantage, business model convergence
JEL Classification: R4, M21, E32

Introduction

The COVID-19 pandemic had an enormous impact on the whole aerospace industry and airlines were no exception. The initial collapse of traffic followed by a few years of recovery yielded pictures of a significantly remodelled sector. Travel patterns have changed and particular segments of the market were recovering with different momentum. These factors, coupled with different characteristics of the two key airline business models (i.e. low-cost and network-legacy), including their resilience to external shocks, had a catalytic effect on further evolution of how airlines do their business. However, the developments that have been observed since 2020 are a continuation of the evolution of airline business models that had been in place long before. Therefore, it can be claimed that the pandemic and its aftermath should be perceived more as a catalytic factor rather than a single trigger of change.

Airline business models have been covered extensively in the subject literature over the past decades, at least since the emergence of the low-cost carrier (LCC) model. The main division line is drawn between this model and network-legacy carriers (NLCs), aka full-service carriers (FSCs), [Belobaba, 2009; Doganis, 2010, pp. 131–155; Vasigh et al., 2010, pp. 9–11;], although the trend of hybridization, which makes the two aforementioned business models converge, has also been extensively discussed recently [Magdalina, Bouzaima, 2021]. On the side of this mainstream discussion on airline business models some authors also mention regional and charter airlines as the business models that complement the usually dichotomous perspective [Adiloğlu Yalçınkaya, 2023].

Even though there is no universal approach to defining the business model [Al-Debei, Avison, 2010], authors focusing on the airline industry generally aim at determining measures applied in order to gain competitive advantage and leading strategic position [Vatankhah et al., 2025]. In the case of airline business models, the discussion is usually focused on value proposition and the logic that is used to create and deliver it, which is in line with how the business model is defined by Osterwalder et al. [2005], Linder and Cantrell [2000], Magretta [2002], Shafer et al. [2005] and others. However, some authors propose a more comprehensive perspective covering (on top of the aforementioned aspects) key resources and activities, market structure, customer resources as well as cost and revenue generation [Vatankhah et al., 2019]. Therefore, the dominating topics as well as differentiating factors that define either of the models are the strategic choices as well as operational and product aspects.

This study aims to investigate the underlying factors within airline business models that contributed to the divergent recovery trajectories observed in the aftermath of the COVID-19 pandemic. While the convergence between low-cost carriers (LCCs) and network legacy carriers had been evident prior to the pandemic, the crisis appears to have acted as a catalyst, accelerating structural and strategic transformations particularly within the legacy carrier model. Consequently, this paper also explores the evolution of airline business models in the post-pandemic context. Notably, a gap in the existing literature has been identified: although

airline business models have been widely studied, the specific developments since 2020 – particularly the accelerated adaptation of network legacy carriers to LCC-dominated market dynamics – remain underexplored..

Airline business models: a literature review

When analyzing pure LCC and NLC business models, there are a few key characteristics that can be used as differentiating factors. Looking from the perspective of the Business Model Canvass (BMC) concept [Osterwalder, Pigneur, 2010], LCCs and NLCs target different customer segments. The latter ones generally cater to a much larger extent to business travellers and are focused on high-yield markets. This has its consequences regarding the channels of communication, distribution, and sales. Network legacy carriers rely on a much wider range of channels to deliver their value proposition. Within this building block lie the key differences between the two business models: not only is there a gap in the scope and quality of the product offered but also this aspect is closely linked to the other BMC building blocks, i.e. key resources, key activities, cost structure, and revenue streams and, to a lesser extent, customer relationship. Low-cost carriers generally offer a simple no-frills product, direct flights, lower frequency, higher network density as well as all-economy and high-density cabin layout. On the other hand, network-legacy carriers offer product bundles that include perks like on-board food and beverages, luggage, etc., lower density networks but with connecting flights and high frequency to cater to business travellers as well as at least to travel classes. LCCs focus on short- and medium-haul flights, while NLCs have a more global reach with intercontinental flights.

This value proposition determines other BMC building blocks. Key resources include people as well as mainly physical resources with aircraft being the crucial asset. LCCs fleets are homogenous, while network-legacy carriers operate different aircraft that give them more flexibility. Similarly, key activities are a consequence of how value proposition is defined and the main difference lies in how the route networks are constructed: NLCs operate a network of routes following the hub-and-spoke model, while low-cost airlines feature point-to-point networks. The key activities are also determined by the competitive strategy employed by either of the business models discussed: LCCs follow the cost leadership approach while differentiation drives the activities of network-legacy carriers. This has implications for cost structure: while low-cost carriers are cost-driven businesses following a lean cost structure aimed at delivering value at lowest possible prices, NLCs are more value-driven and focus more on creating value for their customers.

In terms of revenue streams, low-cost carriers rely on ancillary revenue to a much larger extent than network-legacy carriers. Again, it is a consequence of their value proposition with unbundled products and services. Partly due to operational reasons (more complex network structure), NLCs employ much more complex revenue management strategies compared

to their LCC counterparts. To retain high-yield passengers network-legacy carriers offer frequent flyer programmes to build loyalty with their most valuable customers, a strategy that is nearly non-existent in low-cost carriers.

The differences in the key partners building block are less pronounced than in other areas. While the buyer-supplier relationships look similar (even though the partners themselves might be different mainly due to differences in the value proposition), network-legacy carriers are much more likely to develop strategic alliances, joint ventures, and engage in coopetition.

The analysis underlying the research was based on the business model concept described above. The strategic and operational changes in European network-legacy carriers were scrutinized across all nine building blocks of the BMC methodology and key changes that can be defined as business model developments were identified. With regard to the above observations on the key building blocks of airline business models, the research focus was on the product developments (value proposition) as well as on the strategic orientation and operational aspects. Due to the nature of the problem, the research had a mainly qualitative character and elements of the case study method were employed. In order to determine the quantitative aspect of the changes, selected airline schedules were analyzed in order to identify business, leisure, and mixed-traffic destinations and their respective share in the network. Moreover, the nature of newly launched routes was assessed in order to determine the share of non-business routes being added.

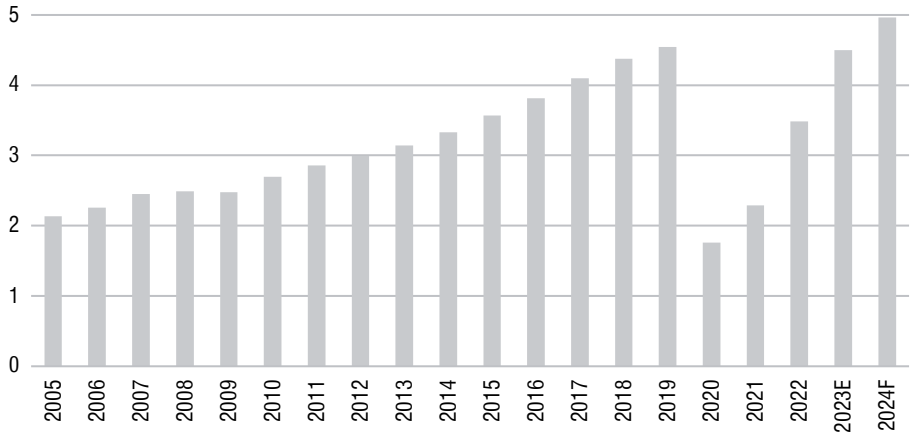
Traffic recovery after the COVID-19 pandemic and the changes in the passenger air transport market

The outbreak of the COVID-19 pandemic in early 2020 led to an unprecedented decline in air travel worldwide. The number of passengers, relative to 2019, decreased by more than 60% (see Figure 1). Scheduled flights were completely suspended for several months in many countries. There had been some recovery in Europe by June 2020 when airlines were again allowed to operate passenger services, but with several significant restrictions. With the rise in new cases of COVID-19 during the fall of that year, additional restrictions on air traffic were reintroduced. The cycle of tightening and loosening restrictions throughout the next year followed a similar pattern. However, some adaptation to operating under pandemic conditions, along with advancements in both SARS-CoV-2 testing and the introduction of widely available COVID-19 vaccinations, meant that air traffic began to recover, despite the still significant restrictions.

From a traffic volume perspective, the global aviation market in 2023 has nearly returned to its pre-pandemic levels. However, this appearance is somewhat misleading, as the traffic structure has undergone significant changes across various dimensions. Many of these structural shifts began during the pandemic itself. The most noticeable changes were geographic in nature. Due to the restrictions on air travel, international traffic – particularly intercontinental

flights – experienced the greatest decline. In contrast, the domestic traffic market fared relatively better, as restrictions were less severe.

Figure 1. Air passengers carried globally (bn) in 2005–2024



Source: Statista, 2024.

Air traffic, especially in 2020 and, to a slightly lesser extent in 2021, became concentrated in large countries with significant populations, primarily in Asia (including China). This shift was also evident in traffic patterns at the world's largest airports. The biggest declines in traffic occurred at major international hub airports (such as Paris CDG, London Heathrow, Amsterdam, New York JFK, Dubai, and Frankfurt), while airports focused on domestic traffic saw less of a decrease. Notably, Guangzhou Airport in China, which primarily handles domestic flights, became the largest airport in the world in 2020 in terms of passengers served [Port Authority NY, 2021].

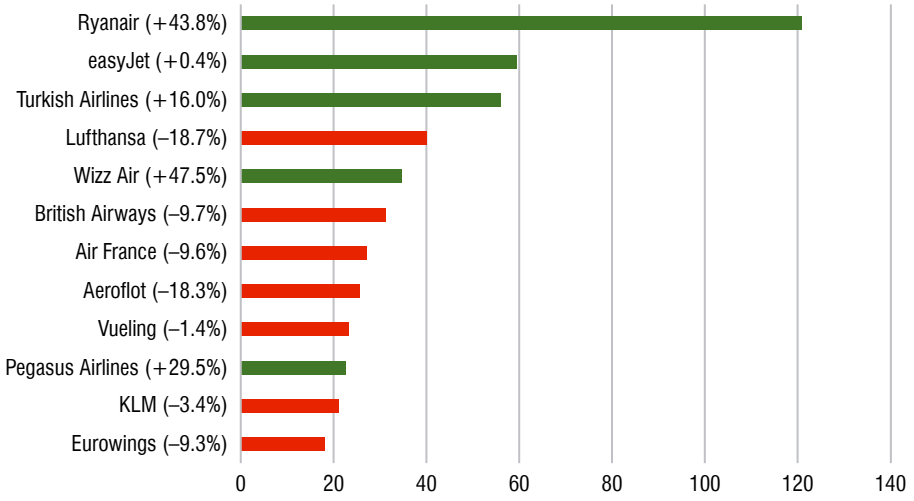
As per CAPA [2022], during the peak travel months of July and August in 2020 and 2021, low-cost carriers in Europe offered more seats than network-legacy carriers compared to their respective capacity before the pandemic. In contrast, during the periods of the greatest restrictions – specifically in the autumn-winter and spring months – LCCs significantly reduced their capacity compared to network-legacy carriers. This highlights the greater operational flexibility of LCCs, a characteristic rooted in their business model, which will be explored further in the next section of the paper.

Starting in July 2021, low-cost carriers have consistently reported a higher proportion of seat capacity compared to network-legacy carriers, relative to the 2019 supply. By the fourth quarter of 2024, most low-cost carriers had increased their capacity significantly compared to the same period in 2019, while many NLCs had still not recovered fully from the traffic losses caused by the COVID-19 pandemic (see Figure 2).

The difference in traffic dynamics between network-legacy carriers and low-cost airlines following the 2020 collapse can be attributed largely to a shift in the structure of demand for air passenger services. On the one hand, the widespread adoption of remote working and

video conferencing during the pandemic likely had a lasting impact on reducing the frequency of business travel [Manca et al., 2023]. On the other hand, months of restricted mobility prompted many people to travel more frequently for leisure once the pandemic restrictions were lifted [Deloitte, 2024]. This latter phenomenon is not only related to increased travel, but more broadly to a surge in consumption following a period of restrictions, often referred to as "revenge consumption" [Park et al., 2022].

Figure 2. Capacity (in millions of seats) of Europe's largest air carriers in Q2 and Q3 2024 (and change relative to the same period in 2019)



Source: Air Service One, 2024.

A key factor supporting private travel was the decline in real airfares. In Europe, the dynamics of airfares remained below the inflation rate from the outbreak of the pandemic until at least mid-2023 [IATA, 2023]. Meanwhile, between 2020 and 2023 nominal wages grew faster than inflation, resulting in an increase in real disposable income [Eurostat, 2024]. Given the high income elasticity of demand for air travel [InterVistas, 2007], this increase in disposable income has contributed to a rise in passenger traffic.

Differences between NLC and LCC business models and their impact on the varying speed of airline business recovery

As evidenced in the literature review, an airline business model is a complex and multi-aspect concept. In this section attention will be drawn to the aspects that have facilitated differentiated dynamics of post-COVID-19 recovery for low-cost and network-legacy carriers. However, even before the pandemic both business models had been converging, which in some cases resulted in airlines following the hybrid business model [Magdalina, Bouzaima, 2021].

In real life, LCC or NLC business models are rarely followed by airlines in their purest form. On the other hand, some of the differentiating factors are sharp enough to provide a clear indication how a given airline should be classified. In this section we focus solely on the differences in airline business models that have influenced the varying dynamics of recovery for airlines operating under each model.

The first major differentiating factor is the focus on different market segments. To a large extent network-legacy carriers are concentrated on serving the business travel segment, while low-cost carriers cater predominantly to leisure and VFR[1] travellers. The differing recovery rates and growth of these two market segments after 2020 have also contributed to changes in the market structure based on the business model.

It is important to note, however, that business travellers also use low-cost carriers. These carriers have enhanced their appeal to business travellers by adopting operational and product features typically associated with network-legacy carriers, such as flexible fare options, flights to and from primary airports (instead of secondary ones), and offering tickets through channels beyond their own distribution networks. As the number of city pairs served by low-cost carriers with direct O-D flights increases, the share of business traffic served by these carriers is likely to keep growing.

One of the key differences between the network-legacy and low-cost business models lies in the carrier's network structure. NLCs operate a hub-and-spoke network, utilizing a central hub with feeder flights, while low-cost carriers follow a point-to-point model, offering direct connections and no connecting flights. Due to its characteristics, such as the independence of demand for each individual connection, the point-to-point model is far more flexible.

In contrast, the hub-and-spoke model, where a carrier sells tickets for specific routes (between two airports in the network, with or without a transfer at a hub), relies on the availability of other routes. Demand for a specific route is fed by other routes, meaning that adding or removing individual routes can affect demand for others.

The flexibility of the point-to-point model allows carriers to launch new routes easily and at a relatively low cost, without requiring large investments in route development or the need to analyze the interdependence with their existing network. In the case of loss-making routes, carriers operating under the point-to-point model can respond more quickly and effectively by adjusting route frequencies or eliminating routes altogether.

For network carriers, this is more challenging, as the profitability of a particular route must be considered in the context of its role within the entire network. In addition to the interdependence of routes, network carriers also face considerations related to their focus on the business travel segment, which requires maintaining a minimum frequency on certain routes [Chiambaretto, Combe, 2023]. Some flexibility is provided by a diversified fleet, with aircraft varying in capacity (i.e. the number of seats in the passenger cabin).

[1] VFR – "Visiting Friends and Relatives" segment of passengers together with leisure travellers make up the "non-business" travel segment.

Another key difference between full-service and low-cost carriers that has influenced their competitive positions is their revenue strategy. In essence, both FSCs and LCCs have two main sources of revenue: ticket sales and ancillaries [Warnock-Smith et al., 2017]. Ancillary revenue is generated from the sale of additional products and services, both offered by the airline itself and by third-party providers. In the latter case, airlines earn commission-based revenue. This includes services such as travel insurance, hotel bookings, or car rentals, which are typically offered during or after the ticket purchase process.

The products and services provided by the carrier itself largely consist of those that were once included in the price of an airline ticket (e.g. checked-in baggage, seat selection, in-flight meals). However, as part of the unbundling process, these services have been separated out to generate additional revenue. This unbundling process was pioneered by low-cost carriers [Gudmundsson, 2023].

At low-cost carriers, the share of ancillary revenues in their total revenue is significantly higher than at network-legacy carriers, primarily due to product differences. Among the 20 airlines with the highest share of ancillary revenues in 2023, none were NLCs [Sorensen, 2024].

In an era when search and metasearch engines are widely used by passengers to find the most affordable fares, low-cost carriers have an advantage in positioning their offer. Although the final total price of an airline ticket (including services and additional products) may sometimes be higher on a low-cost carrier compared to an equivalent offer from a network-legacy carrier, passengers often choose the low-cost option. This is because they are typically guided by the basic fare comparison, and the purchase of additional services occurs only after the tickets have already been bought. However, with the development of more customized search engines embracing AI-powered solutions, this advantage of LCCs may quickly vanish with comprehensive multi-option features.

Countermeasures employed by network-legacy carriers in response to their deteriorating market position: business model evolution

In response to their weakening relative position, the first measures taken by European NLCs were focused on the product area and were primarily aimed at improving efficiency by reducing costs and seeking additional sources of revenue. In fact, this was a continuation of changes initiated long before the outbreak of the COVID-19 pandemic. Thus, the processes of unbundling were deepened: some carriers like Lufthansa gave up offering free catering on short- and medium-haul flights [The Brussels Times, 2020], many carriers restricted baggage allowances by reducing the maximum weight of baggage that can be carried at no extra charge, limiting the number of pieces of free baggage, and even – as in the case of SAS Airlines – limiting (in the case of the cheapest fares) cabin baggage to a small carry-on bag or backpack along the lines of most low-cost carriers [Gračanin, 2021].

A new phenomenon that emerged after the COVID-19 pandemic is the unbundling of services in premium classes. In 2021, Finnair introduced a Business Light fare, which excludes access to the business class lounge, free checked-in baggage, priority check-in, and security screening [Otley, 2021]. Similarly, in 2023 Air France and KLM introduced a similar fare, where the price also excludes lounge access and provides a lower checked-in baggage allowance [Flynn, 2023]. It can be expected that other airlines may introduce similar fares in the future to attract passengers with higher price sensitivity. However, in-depth unbundling in premium classes is unlikely due to the distinct nature of demand in these classes, the higher proportion of business travellers, and in general, demand that is characterized by a relatively low price elasticity.

Another phenomenon that has intensified, particularly since 2022, is the greater focus of network carriers in leisure markets – markets that have traditionally been dominated by low-cost and charter airlines. This shift in market orientation has been driven by the much higher growth in leisure and VFR travel compared to the recovery of the traffic segments traditionally served by network carriers, where business travellers played a pivotal role in generating revenue. The expansion into (mostly) new markets is occurring in two ways: some airlines, particularly those without leisure subsidiaries (e.g., PLL LOT, Austrian Airlines), are expanding their own networks, while others (e.g. Swiss, Lufthansa) are both expanding their own networks and developing the networks of their subsidiary airlines catering to leisure markets. This expansion includes not only short- and medium-haul routes, where low-cost carriers typically dominate, but also intercontinental holiday routes.

This network-legacy carriers' strategy to compete with low-cost carriers (LCCs) through the creation of subsidiaries that follow the low-cost business model more closely than the parent airline (also called the "airline-within-airline" strategy) had been followed long before the COVID-19 pandemic [Graham, Vowles, 2006; Pearson, Merkert, 2014; Raynes, Tsui, 2019]. However, the unequal recovery of NLCs gave it a new momentum. Expanding into leisure markets offers undeniable benefits for network-legacy carriers. Due to the slower recovery of traffic on their typical routes, it allows them to make use of spare capacity within their own networks and by transferring aircraft to subsidiary carriers serving leisure markets (as seen with Lufthansa and Eurowings/Eurowings Discover). Given the high seasonality of traffic in Europe, this strategy also enables NLCs to offset the much lower demand in the fourth and first quarters of the year by launching routes with reversed seasonality to destinations like Egypt, the Canary Islands, the United Arab Emirates, and ski resorts as well as the Caribbean and South-East Asia when it comes to long-haul flights.

However, entering this type of market presents several challenges due to a mismatch between the nature of these routes and the operational characteristics of network-legacy carriers. In many cases cabin configurations of NLCs are less than optimal for leisure and VFR markets where lower standards (e.g. seat pitch) are accepted and where the demand for premium travel classes is much lower. This makes price competition with LCC more difficult, as the costs per seat kilometer incurred by NLCs are likely higher. Moreover, for holiday connections,

passengers prefer strongly direct flights, a preference shaped by the offerings of low-cost and charter carriers. As a result, network-legacy carriers can only offer similar services on routes to and from their hubs. While they do provide connecting flights to and from leisure destinations, the appeal of such solutions is much lower for travellers. This often necessitates offering lower prices, which again impacts negatively the profitability of these routes. Furthermore, the role of these connections within the network (specifically, their contribution to feeding passenger flows) is limited. Consequently, the development of leisure markets has a relatively minor effect on strengthening the overall network and cannot be considered a long-term alternative to expansion in markets traditionally served by network carriers.

The marketing strategies of network-legacy carriers rely heavily on the loyalty built among passengers, with frequent flyer programmes playing a central role. However, passengers in leisure markets tend to display lower loyalty and are more price-driven when selecting a flight, which can diminish the effectiveness of loyalty-based marketing. On the other hand, the introduction of routes previously served only by low-cost and charter airlines may attract passengers loyal to network-legacy carriers, even if the price of the service is higher.

Therefore, a strategy of creating an airline-within-airline, i.e. a low-cost subsidiary, seems to be much better tailored to the purpose of competing with LCCs than simply adding leisure destinations to the typical network of a legacy carrier. However, this approach is only an option for the largest airlines and airline groups (see Table 1). Smaller airlines do not have enough market potential to launch another airline that could successfully compete with low-cost players with overwhelming market power.

Table 1. European low-cost/leisure subsidiaries of legacy airlines

Legacy airline/group	Low-cost/leisure subsidiary
Lufthansa Group	Eurowings, Discover Airlines, Edelweiss Air
Air France-KLM	Transavia, Transavia France
IAG	Vueling, Level, Iberia Express
British Airways	BA Euroflyer
AJet	Turkish Airlines

Source: own elaboration.

For smaller airlines, however, the only option to enter the fast-growing leisure market is to expand their own networks with such routes, with the advantages and disadvantages mentioned above.

An interesting case study is the situation in the German market, where the Lufthansa Group is expanding its route network from non-hub airports through its subsidiaries, Eurowings and Discover. This creates an alternative to low-cost carriers, in addition to supplementing Lufthansa's own network. This strategy is made possible primarily due to the Lufthansa Group's dominant market position in Germany, which is reinforced by strong brand loyalty. Additionally, the relatively small presence of low-cost carriers in this market,

coupled with the weakness of their offerings (network density, product), contributes to the success of this strategy. Similar situations can be observed in Switzerland, the Netherlands and France, where the legacy carriers of the respective countries have a fairly strong position in their home markets.

Discussion

The modifications to the business models introduced by network-legacy carriers are part of the broader trend of hybridization that has been observed for years [Magdalina, Bouzaima, 2021]. These actions are a natural continuation of processes that began even before the COVID-19 pandemic. The pandemic itself, along with its effects on the competitive position of NLCs, should be viewed as a catalyst for the evolution of this business model.

Among the strategies aimed at addressing the post-pandemic decline in competitive position and market share, the attempt by network-legacy carriers to compete directly with low-cost airlines in leisure markets is particularly noteworthy. This shift is significant not only due to its novelty, but also because of the potential opportunities and risks associated with this change to the NLC model.

Looking from the perspective of the Business Model Canvas, the evolution of the network-legacy business model focuses on four aspects out of nine: value proposition, key activities, customer segments, and revenue streams. As discussed in the paper, specific differences between network-legacy and low-cost carriers ensured a more speedy recovery of the latter ones, which encouraged network-legacy carriers to adopt some of the features of the low-cost model, the most prominent aspect being network evolution and exposure to leisure markets. Between 2022 and 2026, LOT Polish Airlines launched 17 routes out of their Warsaw hub only (plus a few more from regional airports). Only 4 out of this number can be considered business routes, 5 are pure leisure routes (like Tenerife or Rovaniemi) or mixed, i.e. with a relatively high share of leisure passengers, but with a fraction of business travellers (e.g. Rome, Lyon, Lisbon). Before the pandemic, 90% of LOT routes were of business nature, in early 2026 it will be only 80%. The Lufthansa Group has increased their presence through its leisure-oriented subsidiaries. Eurowings Discover was launched in 2021 and subsequently transformed into Discover Airlines in September 2023. In 2025 their fleet consisted of 16 narrow-body and 14 wide-body aircraft and the airline operated flights to 70+ leisure destinations, most of them on a seasonal basis. Fast expansion of another leisure-oriented airline of the Lufthansa Group, Eurowings has also been observed. In the summer 2024 flight season more than 75% of new European destinations were launched by leisure-oriented airlines within the Lufthansa Group and legacy carriers added only 20 new destinations and only half of these were business-travel ones [Lufthansa Group, 2024].

Summary

The developments in the passenger air travel market following the COVID-19 pandemic have altered the balance of market forces. Network-legacy carriers found themselves at a disadvantage compared to LCCs due to the shifting demand structure. A significant decline in the market share led network carriers to seek solutions to offset the negative impact and strengthen their competitive position against LCCs. As a result, further hybridization of the NLC business model became evident, particularly in the product area, which was reflected in the progressive unbundling process, even within premium classes. The hybridization was not only deepened, but also exploration of new areas of business model convergence was started. As a consequence, full-service carriers sought to expand into leisure and VFR markets in order to capitalize on spare resources and diversify their revenue streams. However, an analysis of the business model of these carriers reveals several challenges resulting from this strategy, particularly due to the significant mismatch between the new direction of development and the operational characteristics of a network-legacy carrier. Consequently, it can be expected that for some carriers this expansion into leisure markets may be temporary, and should the markets typical of network carriers return to higher growth rates, they may refocus on serving those markets, potentially abandoning the leisure segment or limiting their presence to the most profitable routes.

The presented research and its outcome can be a valuable insight for airline managers as it not only summarizes the developments observed for the last couple of years, but also points out potential inconsistencies with the legacy business model and possible consequences from the operational and business points of view.

Further research of the developments described and analyzed in this paper could focus on the sustainability of network legacy carriers venturing into leisure markets. In this respect the cohesion of the business model should be assessed as well as possible measures to incorporate better leisure routes into typical legacy airlines networks. Moreover, quantitative aspects of leisure markets exposure of airlines could be researched further. However, it requires access to industry databases that comes at a cost, therefore, proper funding should be secured for such a research endeavor.

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