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Justifying the Cost of Implementing Contactless Travel in Non-Primary Airports: A European Perspective

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In recent years, the aviation industry has witnessed a significant shift towards the implementation of contactless travel solutions, particularly in the wake of the COVID-19 pandemic. Non-primary airports in Europe, often constrained by limited budgets and lower passenger volumes, are increasingly exploring the feasibility of adopting such technologies to enhance operational efficiency, passenger experience, and safety. According to a report by SITA, 64% of airports aim to roll out self-boarding gates using biometric and ID documentation by 2023, a threefold increase from 2020 (IBM, n.d.). Frankfurt Airport, one of Europe's busiest hubs, has taken the lead in this domain by implementing facial recognition systems from check-in to boarding, in collaboration with SITA and NEC, offering a contactless, frictionless travel experience (Simple Flying, n.d.; Schengen Visa Info, n.d.). This move not only revolutionizes the airport experience but also sets a precedent for other non-primary airports to follow.

The transition to contactless travel is further supported by the adoption of mobile-enabled kiosks at Mumbai's Chhatrapati Shivaji Maharaj International Airport, which significantly reduces the need for physical contact (SITA, n.d.). The European Union Agency for the Operational Management of Large-Scale IT Systems in the Area of Freedom, Security, and Justice (eu-LISA) has also emphasized the importance of technology in enhancing the EU's travel ecosystem, with initiatives like the Digital Travel Credential (DTC) and the Visible Digital Seal (VDS) being developed by ICAO (eu-LISA, 2021). Moreover, Avinor's trial of touchless technology across 44 airports, allowing passengers to check in, drop bags, proceed through security, and board their flight, exemplifies the industry's steady steps towards restoring confidence in air travel (Phocuswire, n.d.).

The first European airport to offer a completely contactless journey using biometrics was achieved through a collaboration between SITA and Fraport, with a goal to equip at least 50% of all check-in kiosks, pre-security, and boarding gates with the new technology (50skyshades, n.d.). Additionally, initiatives like London's Project Proteus aim to promote open-loop contactless travel across public transport, further highlighting the growing trend towards seamless and efficient travel experiences (PYMNTS, 2022). This paper investigated the cost of implementing contactless travel in non-primary airports from a European perspective, by analyzing the economic, operational, and safety benefits that these technologies bring to the aviation sector.

Focusing on the topic, this paper will delve into a comprehensive analysis that spans across various stakeholders involved in the aviation sector. The scope of our investigation is twofold: on the one hand, we will meticulously examine the financial implications of adopting contactless technology in smaller airports, assessing the upfront costs against the long-term benefits. This financial review will not only encompass the direct expenses associated with the installation and maintenance of contactless systems but will also consider the potential for increased

operational efficiency, reduced labor costs, and enhanced revenue opportunities through improved passenger experiences. The pandemic has not only expedited the push towards contactless solutions in the aviation industry but has also illuminated the challenges and struggles faced by airports in adapting to these new norms, especially within the context of fluctuating passenger volumes and stringent health protocols.

For instance, the research highlighted by the International Civil Aviation Organization (ICAO, 2020) indicates a nuanced recovery trajectory for the aviation sector, suggesting that airports, particularly smaller ones, may face prolonged periods of operational and financial strain as they work to implement contactless technologies amidst uncertain passenger demand. Moreover, airports are heavily investing in biometric technology to facilitate contactless travel, with a significant uptick in the deployment of self-boarding gates using biometric and ID documentation expected by 2023—a threefold increase from 2020, as reported by IT firm SITA's Air Transport IT Insights. This underscores the widespread commitment to enhancing passenger safety and convenience, albeit with the backdrop of financial and logistical challenges.

Furthermore, examples of innovative implementations, such as Rezcomm's Contactless Fast Track Booking and Queueless Journeys, demonstrate the industry's efforts to minimize virus transmission and physical contact points. These initiatives reflect a broader trend towards leveraging technology to maintain operational continuity and rebuild traveler confidence. However, the adoption of such technologies is not without its hurdles, with airports grappling with the dual challenges of ensuring cybersecurity amidst rising cyber-attacks and navigating the financial implications of reduced traffic levels and increased technology investments.

This context of real-world struggles and strategic adaptations by airports in the wake of COVID-19 enriches our exploration of contactless technology's role in the aviation sector. By examining the experiences of airports that have faced challenges in this transition, we gain critical insights into the operational, financial, and strategic considerations that underpin the move towards a more contactless, efficient, and passenger-centric airport ecosystem. This narrative serves as a connecting thread, weaving together the theoretical analysis with practical examples of airports striving to navigate the complexities of post-pandemic recovery and technological innovation.

On the other hand, the impact of this transition on key stakeholders—namely airlines, ground handling agencies, and passengers—will be thoroughly evaluated. For airlines, the focus will be on how contactless travel can streamline operations, enhance passenger flow, and potentially increase customer satisfaction and loyalty, all of which are critical in the highly competitive aviation industry. Ground handling agencies, which play a pivotal role in airport operations, will be

analyzed in terms of how contactless solutions could affect their workflows, efficiency, and cost structures. Finally, the passenger perspective is integral to this discussion; this paper will explore how the adoption of contactless travel can improve the travel experience, reduce stress and wait times, and possibly influence the choice of airports, thereby impacting passenger traffic and revenue for non-primary airports. A noteworthy example is Dubai International Airport, which has pioneered the use of a 'smart tunnel' at immigration control. This innovative approach leverages facial recognition technology to expedite passenger queues, embodying the shift towards minimizing physical contact and enhancing passenger throughput efficiency. Similarly, the deployment of fully autonomous delivery robots at Cincinnati/Northern Kentucky International Airport (CVG) represents a forward-thinking adoption of contactless services. These robots, operated by Ottonomy, offer contactless delivery of food and retail items directly to passengers, illustrating the potential for technology to redefine the airport experience.

Moreover, the strategic investment in biometric technology, as highlighted by IT firm SITA's Air Transport IT Insights, underscores a broader industry trend. With 64% of airports planning to roll out self-boarding gates using biometric and ID documentation by 2023, the push towards contactless operations reflects a significant commitment to transforming airport infrastructures and operations.

These examples underscore the complex interplay between technological innovation, operational efficiency, and passenger satisfaction in the aviation industry's post-pandemic recovery. For airlines, the adoption of contactless technologies offers a pathway to streamline operations and potentially enhance customer loyalty through improved travel experiences. Ground handling agencies stand to benefit from increased efficiency and reduced operational costs, while passengers may enjoy a more seamless, stress-free travel experience. Through the lens of these real-world applications, the potential benefits of contactless technology adoption in non-primary airports become increasingly evident, highlighting the importance of strategic investments in technology to navigate the challenges and leverage the opportunities presented in the post-COVID era.

By integrating financial analysis with stakeholder impacts, this paper presents a holistic view of the feasibility and justification for implementing contactless travel technologies in Europe's non-primary airports. This comprehensive approach will enable us to not only assess the viability of such investments but also to understand their broader implications for the future of aviation in Europe. Through this exploration, we aspire to contribute meaningful insights into the decision-making processes of airports contemplating the transition towards a more seamless, efficient, and passenger-friendly travel experience.

Problem

The implementation of contactless travel technology in non-primary airports represents a critical evolution in the aviation industry, particularly under

the lens of the European perspective. This advancement is not merely a response to the increasing demand for efficient and safe passenger processing but is also a strategic move to enhance competitiveness and sustainability in the face of evolving passenger expectations and the burgeoning low-cost carrier (LCC) market.

Review of the Literature

The adoption of shared autonomous vehicles (SAVs) and dynamic ride-sharing (DRS) systems presents a glimpse into the potential future of contactless airport travel, offering insights into cost savings and operational efficiencies. Fagnant and Kockelman (2018) highlighted that such technologies could significantly reduce service times and travel costs for users, even considering the logistics of non-direct routings and passenger pickups. This efficiency is crucial for non-primary airports aiming to increase their appeal to both airlines and passengers by minimizing ground handling times and costs (Fagnant & Kockelman, 2018)

The European low-cost carrier (LCC) industry's evolution also offers valuable insights into passenger behavior and demand elasticity, which are essential factors in justifying the investment in contactless technologies. Morlotti et al. (2017) investigated the price elasticity of demand, revealing significant variances across different dimensions, suggesting that the efficiency and cost-effectiveness of airport operations directly influence airline and passenger choices, especially for LCCs that prioritize low operational costs.

In addition, Garg et al. (2020) explored the integration of IoT-based models for contact tracing within the airport ecosystem, emphasizing the role of technology in enhancing health security and operational efficiency. The study's focus on privacy-preserving, decentralized data management underscores the potential for contactless solutions to address current and future challenges in airport management, including passenger health and security concerns.

Moreover, the strategic positioning and cost-effectiveness of airports are directly impacted by the choice of access modes, as illustrated by Birolini et al. (2019), who assessed the introduction of direct rail services to Milan-Bergamo airport. Their findings highlight the importance of enhancing airport accessibility to maintain and grow passenger volumes, suggesting that investments in contactless and seamless travel options could significantly influence passenger choice and satisfaction.

Exploring the realm of contactless travel in non-primary airports from a European perspective presents a unique challenge, as direct research on this specific topic appears to be sparse. While numerous studies have ventured into the domains of airport efficiency, the adoption of new technologies, and the dynamics of low-cost carriers within the European aviation sector, a targeted investigation into the cost justification of implementing contactless solutions in non-primary airports remains largely unexplored.

For instance, Fagnant and Kockelman (2018) delved into the potential of shared autonomous vehicles at airports, offering insights into operational efficiencies and cost savings, yet their focus does not specifically address the European context, or the unique challenges faced by non-primary airports. Similarly, Morlotti et al. (2017) analyzed the price elasticity of demand in the European low-cost carrier industry, revealing critical insights into passenger behavior and demand sensitivity. However, their research primarily orbits around pricing strategies rather than the technological advancements of contactless travel.

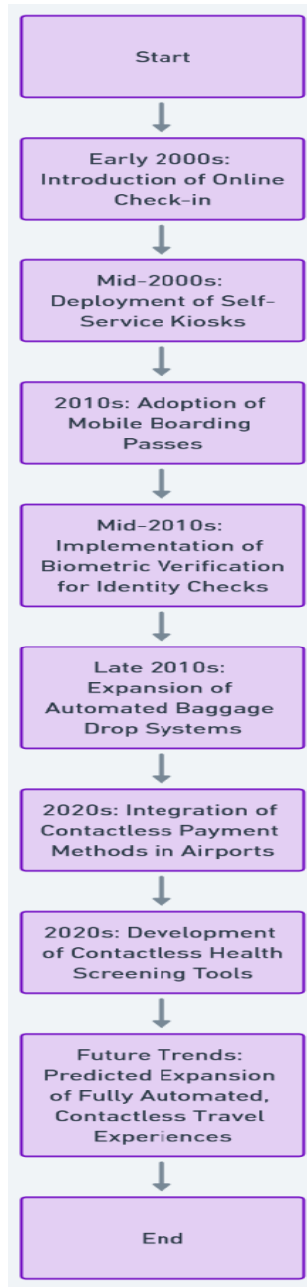
Moreover, the study by Garg et al. (2020) on IoT-based contact tracing models introduced innovative approaches to enhancing passenger safety and efficiency through technology, yet it stops short of exploring the economic implications of such technologies in the specific setting of non-primary European airports.

Birolini et al. (2019) provided a comprehensive analysis of access mode choices to low-cost airports, highlighting the importance of transportation links to airport accessibility. While their findings contribute valuable knowledge on passenger preferences and behavior, the direct correlation between these aspects and the implementation of contactless travel systems in non-primary airports is not explicitly made.

The Contributing Factors

Figure 1 illustrates the progressive adoption of technology in airports, a narrative that underscores the transition from traditional to digital methods to enhance operational efficiency and passenger experience.

Figure 1
Timeline of Technology Adaption



Beginning in the early 2000s with the introduction of online check-in, the trajectory shows a consistent drive towards automation and contactless solutions.

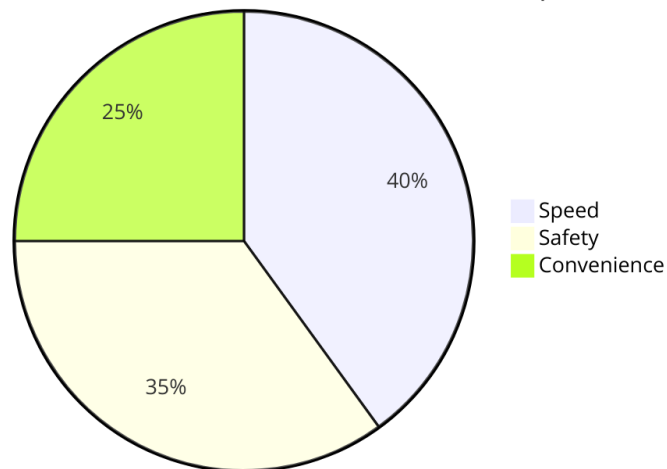
The mid-2000s marked the deployment of self-service kiosks, followed by the adoption of mobile boarding passes in the 2010s. The trend continued mid-decade with the implementation of biometric verification for identity checks, streamlining security processes. By the late 2010s, the expansion of automated baggage drop systems further reduced passenger processing times.

The 2020s have seen the integration of contactless payment methods and the development of contactless health screening tools, a response to health safety needs. Anticipated future trends suggest a complete transformation towards fully automated, contactless travel experiences. This evolution aligns with the broader technological modernization at regional airports, which is critical for cost reduction and efficiency improvements, addressing the financial and operational challenges as noted by Remencová and Novák Sedláčková (2021) in their discussion of the potential impact of digital technology modernization on regional airports.

Figure 2

Passenger Preference While Travelling

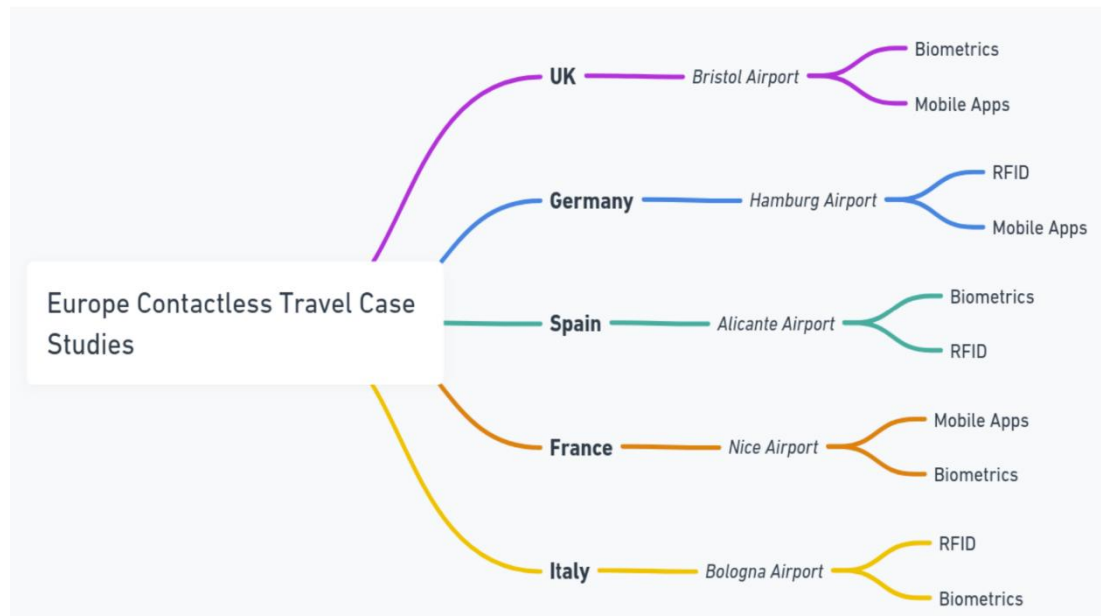
Passenger Preferences for Contactless Travel Options



The pie chart titled "Passenger Preferences for Contactless Travel Options" presents a distribution of passenger priorities, with a 40% majority favoring speed, 35% valuing safety, and 25% preferring convenience when it comes to contactless travel options at airports. This preference reflects the evolving demands of passengers who are increasingly favoring efficiency and minimal physical interaction, particularly in the wake of the COVID-19 pandemic. The emphasis on speed indicates a desire for quick transitions through airport processes, while the focus on safety underscores the heightened awareness of health risks in public spaces. The convenience factor likely encompasses the ease of use and accessibility

of contactless services. These preferences are crucial for airport management as they adapt to changing behaviors and expectations, offering insights into how technological innovations and contactless solutions can be tailored to improve passenger experience and airport operations (Halpern et al., 2020). Understanding these preferences is essential for enhancing non-aeronautical revenue streams and for airport planners and managers to make informed decisions regarding passenger services and airport business opportunities, as discussed in the text.

Figure 3
European Contactless Travel Case Studies



Drawing on the methodology outlined by Remencová and Novák Sedláčková (2021), we can compare the financial implications of implementing check-in kiosks at M.R. Štefánik Airport in Bratislava and Košice Airport.

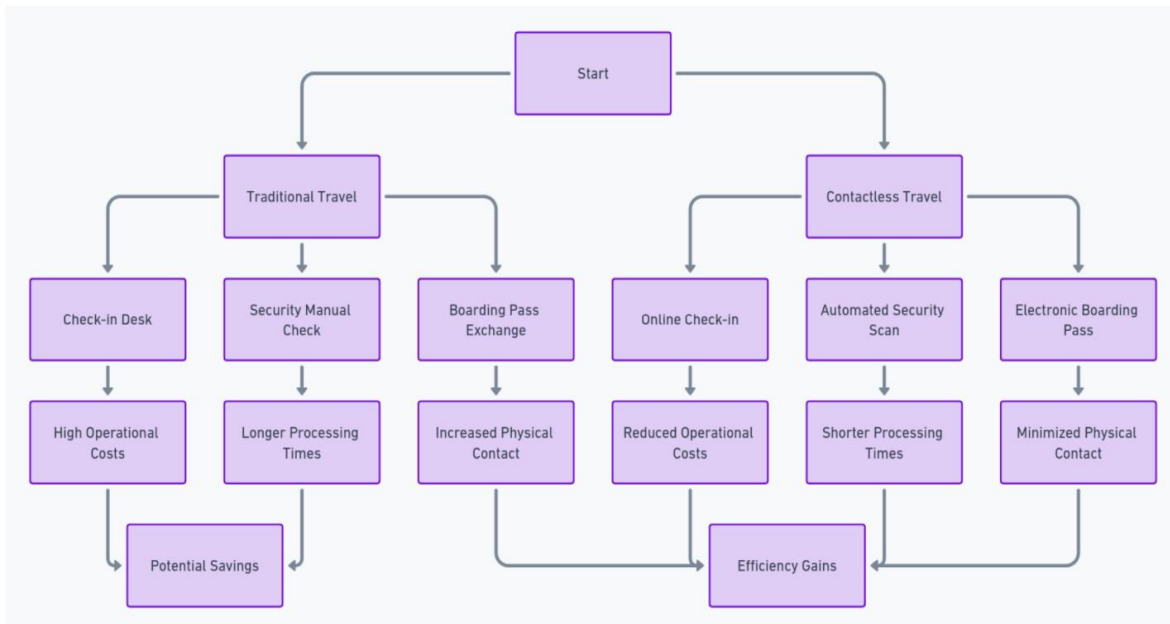
For M.R. Štefánik Airport in Bratislava, the annual costs per employee are €19,286.04. With the cost of one check-in kiosk at €3,850, the financial savings per employee are €15,436.04, resulting in a percentage cost saving of approximately 80.04%.

Comparatively, Košice Airport, with a higher annual cost per employee of €21,260.53, realizes financial savings of €17,410.53 per employee when replacing a staff member with a check-in kiosk. This translates to a percentage cost saving of about 81.89%.

Applying this approach to the airports listed in the "Europe Contactless Travel Case Studies" image and assuming similar cost structures and savings rates, we can infer those investments in digital technologies such as biometrics, RFID, and mobile apps could lead to substantial cost savings for these airports as well. These technologies not only potentially reduce labor and training costs but also may enhance passenger experience by offering speedier and safer check-in processes, aligning with the preferences highlighted in the pie chart analysis. We can hypothesize that if Nice Airport were to implement check-in kiosks and their associated costs were similar to those of Košice and Bratislava, we could expect a similar range of cost savings and efficiency improvements. For instance, if Nice Airport incurs an average annual cost per employee comparable to Košice Airport (€21,260.53), and the cost of one check-in kiosk remains constant (€3,850), the financial cost savings and percentage cost savings could be extrapolated for Nice Airport under these assumptions.

To perform a detailed comparative analysis, we would need specific financial data from each of the airports mentioned in the case study image. However, based on the figures from Remencová and Novák Sedláčková's work, it is reasonable to assume that the integration of such digital technologies at Bristol, Hamburg, Alicante, Nice, and Bologna Airports would likely yield significant cost savings while modernizing the travel experience.

Figure 4
Comparative Cost Analysis Chart



The diagram presents a comparative analysis of traditional versus contactless travel processes at airports, illustrating the potential for increased efficiency and cost savings through the adoption of digital technologies. Traditional travel typically involves processes like manual check-in at desks and security checks, leading to high operational costs and longer processing times, and an increase in physical contact between passengers and staff. These aspects can be optimized by implementing contactless solutions, as discussed by Kalakou and Moura (2021).

In the context of contactless travel, online check-in and automated security scans lead to reduced operational costs and shorter processing times. Electronic boarding passes minimize physical contact, enhancing both safety and passenger convenience. These innovations reflect strategic decisions that airport managers can take, aligning with Kalakou and Moura's suggestion that airport planners can use analytical configuration methods and discrete choice models, along with marketing analysis, to evaluate the usage of airport areas and make data-driven decisions for the airport's layout and service offerings.

The potential savings and efficiency gains from contactless travel options can be significant, as they allow for a more dynamic use of retail and service areas. For instance, adjusting product offerings for international and domestic passengers during different times of the day or seasons can enhance passenger satisfaction and

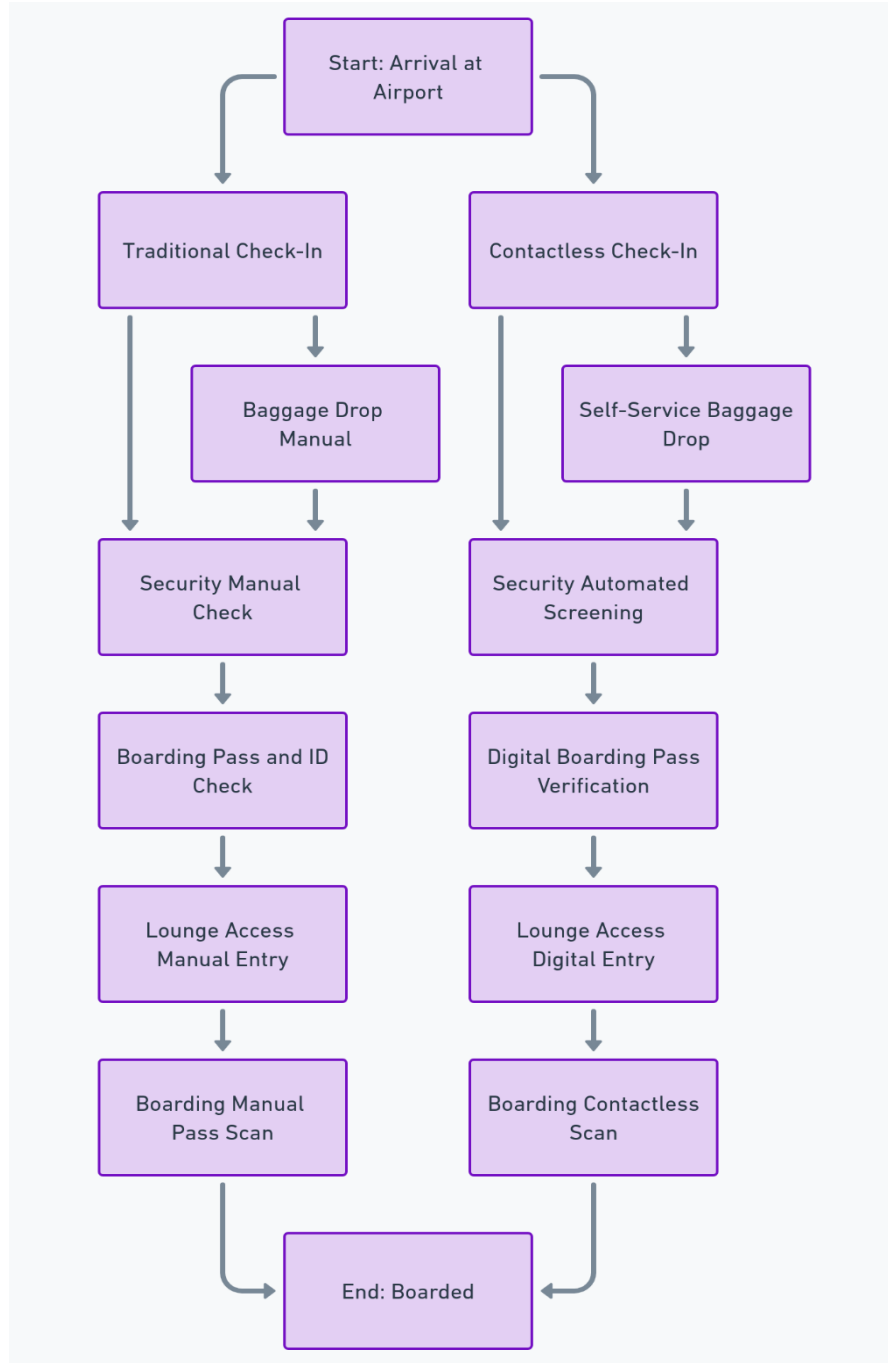
airport revenue. Strategic-level decisions, like the relocation of customs control as mentioned by Kalakou and Moura, can lead to a better configuration of passenger flow, ultimately improving the airport's financial performance and passenger experience.

Investing in contactless technology, such as check-in kiosks, can lead to substantial cost reductions for airports. These kiosks typically cost a fraction of the annual expense associated with staffing check-in counters. For example, if a check-in kiosk costs around €3,850 and replaces tasks done by an employee costing the airport €21,260.53 annually (as per the data from the Kosice Airport analysis), the immediate cost savings per employee replaced are €17,410.53, translating to an approximate 81.89% reduction in costs per replaced function.

However, the introduction of such technology is not without its challenges. For some passenger demographics, particularly older passengers, there may be resistance to using digital services, which can necessitate additional support or alternative services to maintain customer satisfaction. Yet, the push towards digital adoption has been accelerated by the pandemic, with a broad range of demographics now more familiar and comfortable with technology use.

The operational reliability of check-in kiosks is another consideration. While they can occasionally malfunction, mitigating strategies such as having a dedicated maintenance team or multitasking staff can minimize service disruptions. Furthermore, the savings from reduced staffing needs can be reallocated to maintenance and support services for these kiosks. For instance, if an airport employs a technician at a cost similar to a check-in staff member, the technician could oversee multiple kiosks, maintaining the operational savings brought about by the technology.

Figure 5
Traditional vs Contactless Passenger Travel Process



This flowchart delineates the journey of a passenger through an airport, comparing traditional processes to contactless alternatives, reflecting a transformative shift in airport operations aimed at efficiency and safety, especially relevant in the context of the COVID-19 pandemic.

Starting with the arrival at the airport, passengers have the option of either proceeding with traditional check-in—which involves interacting with airport staff and potentially longer queues—or opting for contactless check-in, which leverages digital technology for a more streamlined experience.

In the traditional model, following check-in, passengers engage in a manual baggage drop, subject themselves to a manual security check, have their boarding pass and ID checked by an airport employee, manually enter airport lounges, and finally have their boarding pass scanned manually before boarding.

Conversely, the contactless pathway allows for a self-service baggage drop, automated security screening, digital boarding pass verification, digital entry to lounges, and a contactless scan of the boarding pass before boarding the aircraft. This model notably reduces operational costs and passenger wait times, decreases the need for staff, and minimizes physical contact, enhancing overall service quality (Wilson, 2020).

However, while contactless options offer numerous advantages, they can also present challenges, particularly for passengers less comfortable with digital technology, such as some older passengers. These passengers may prefer the assurance of face-to-face interactions. Thus, airports may need to maintain a hybrid model to cater to all passenger preferences, ensuring assistance is available for those who require it while still capitalizing on the efficiencies provided by technology (Remencová & Novák Sedláčková, 2021).

The digital transformation in airports aligns with the broader trend towards minimizing physical contact, as analyzed by Kalakou and Moura (2021), who suggest that strategic decisions, supported by analytical configuration methods and discrete choice models, can optimize the use of airport areas and enhance non-aeronautical revenue streams.

Discussion

In assessing the financial and operational implications of adopting digital check-in kiosks at airports, a significant disparity in costs becomes evident when compared to traditional employee-based check-in processes. Drawing from the case studies of M.R. Štefánik Airport in Bratislava and Košice Airport, the cost of employing a worker for check-in activities amounts to €19,286.04 annually. In contrast, the acquisition and commissioning of a single check-in kiosk are estimated at €3,850, denoting a substantial potential saving in labor costs (Remencová & Novák Sedláčková, 2021).

This cost efficiency is not trivial; at M.R. Štefánik Airport, the implementation of one automated machine could translate into an 80.03% savings

in labor costs, equating to €15,436.04 per annum. Similarly, Košice Airport could see an 81.89% reduction, amounting to €17,410.53 in annual savings. These figures highlight an opportunity for airports to reallocate financial resources towards other areas that could enhance operational efficiency or passenger experience.

However, the decision to integrate such technology should not be solely financially driven. The user demographic must be considered, particularly the elderly or those less familiar with digital interfaces, who may prefer traditional methods and face-to-face interactions, which are perceived as more informative and reassuring (Wilson, 2020).

Furthermore, the implementation of check-in kiosks must be juxtaposed against the backdrop of the COVID-19 pandemic, which has accelerated the adoption of contactless technologies. The pandemic has underscored the importance of minimizing physical interactions, thereby catalyzing changes in both passenger behavior and airport operational models. It has propelled a shift towards technological solutions that not only enhance safety but also offer efficiency gains.

Despite the clear financial benefits, the introduction of automated machines is not without challenges. The reliability of such devices is a concern, as malfunctions could disrupt service. However, effective contingency plans, such as the deployment of multitasking staff trained to address such issues, can mitigate these risks. Strategically, this approach allows airports to maintain a high level of service continuity while still realizing the cost benefits of automation.

In conclusion, while the deployment of digital check-in kiosks presents a compelling case for cost savings and operational efficiency, airports must adopt a holistic strategy that considers financial viability, passenger demographics, and service reliability. This strategy should be underpinned by robust planning and the flexibility to adapt to evolving passenger behaviors and preferences, as well as unexpected operational challenges (Kalakou & Moura, 2021).

Conclusions

The digital transformation of airports extends beyond mere technological adoption; it is fundamentally about streamlining passenger flow and enhancing the travel experience. The strategic integration of systems like check-in kiosks, self-service baggage drops, and NFC-enabled services can significantly reduce operational costs and improve service quality, which are crucial in non-primary airports where resource optimization is often more critical (ACI Europe, 2017).

Considering the research by Kalakou and Moura (2021), we can infer that passenger behavior in airport terminals is influenced by the availability and convenience of digital options. Their findings indicate that specific passenger demographics, notably those traveling for tourism or engaging in discretionary activities, show a clear preference for self-service technologies. This preference underscores the importance of contactless travel options in enhancing passenger satisfaction and airport revenue.

The conclusion of Dragović et al. (2021) adds another dimension, emphasizing that contactless technologies not only facilitate a smoother passenger experience but also provide a secure and user-friendly way to navigate through the airport ecosystem. These technologies can be leveraged for marketing and brand differentiation, which is particularly beneficial for non-primary airports looking to attract and retain a diverse passenger base.

However, implementing such technologies comes with its set of challenges. As suggested by Remencová and Novák Sedláčková (2021), the introduction of digital check-in kiosks at regional airports, while cost-effective, requires careful consideration of the user demographic and the provision of adequate support to those less familiar with digital technologies.

In synthesizing these insights, the paper concludes that the implementation of contactless travel technologies in non-primary European airports is a financially justifiable and strategically sound decision. The initial investment in digital transformation can yield long-term savings, improve operational efficiency, and enhance the passenger experience. Non-primary airports, which may not have the same financial flexibility as their primary counterparts, stand to benefit significantly from the cost savings and operational efficiencies provided by such technologies.

Furthermore, the current climate, accelerated by the COVID-19 pandemic, has heightened the necessity and acceptance of contactless travel. This shift in passenger preferences represents an opportunity for airports to reimagine their service offerings and infrastructure to align with the new normal of travel.

In conclusion, while the investment in contactless technology at non-primary airports necessitates a significant initial outlay, the long-term benefits—cost savings, enhanced efficiency, and improved passenger experience—far outweigh the initial costs. Strategic planning and a nuanced understanding of passenger behavior are imperative to ensure that the transition to contactless systems is both successful and sustainable.

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