Artificial Intelligence and Airport Retail Profitability: A Management Framework for Enhancing Non-Aeronautical Revenue

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Abstract

Retail is one of the main sources of non-aeronautical revenue for airports, yet many airport shops are still managed with little passenger segmentation, fixed promotions and reactive inventory planning. Artificial intelligence (AI) offers new ways to improve these decisions. This paper examines how AI can support airport retail management in seven areas: passenger analytics, demand forecasting, personalized marketing, inventory optimization, pricing, passenger-flow analysis and real-time customer engagement. Drawing on an integrative review of research on airport commercial management, passenger shopping behavior and AI in retail, we develop a management framework that links data inputs and AI applications to retail decisions and profitability indicators, such as conversion rate, average transaction value and sales per passenger. The main argument is that AI helps airports and concessionaires move from a passenger-volume model to a passenger-value model. In this model, profit depends less on how many passengers pass through the terminal and more on how much value each passenger creates. The framework differs from earlier work in two ways. Unlike studies of the determinants of non-aeronautical revenue, it treats passenger, flight and dwell-time characteristics as inputs that AI can turn into retail decisions; unlike general studies of AI in retail, it specifies the airport-specific conditions, such as limited dwell time, one-off encounters with passengers, concession contracts and fragmented data, under which these links are likely to hold. Tirana International Airport is used as an illustrative case, and sourced contextual evidence is kept separate from the analytical propositions derived from the framework. The paper also assesses the limits of the proposed links, compares the framework with previous studies and offers practical recommendations for airport operators, duty-free retailers and concessionaires.

Keywords: ***Artificial Intelligence; Airport Retail Management; Non-Aeronautical Revenue; Passenger Analytics; Retail Profitability***

1. Introduction

Airports today are much more than transport infrastructure. They are commercial places where income comes not only from aeronautical activities, such as landing fees and passenger charges, but also from non-aeronautical activities. These include retail, duty-free shops, food and beverage, car parking, advertising, lounges and real estate. Non-aeronautical revenue matters because it lets airports diversify their income, depend less on airline charges and cope better with difficult periods in

the market. Airports Council International notes that commercial activities such as retail, dining and parking are a key part of airport financial sustainability (Cheglatonyev, 2025). Retail concessions are especially important, since they are the leading source of non-aeronautical revenue for airports (International Civil Aviation Organization [ICAO], n.d.).

Airport retail has traditionally depended on passenger numbers, shop location, brand mix, duty-free prices and impulse buying. However, more passengers do not automatically mean more profit. Many airports have high traffic but low conversion rates, because passengers do not enter the shops, do not find products they want, have little time, or ignore generic promotions. Research shows that passenger and flight characteristics have a clear effect on retail income, including the share of buyers and the spending per flight (Choi & Park, 2022). In other words, retail results depend not only on how many passengers there are, but also on who they are, why they travel, where they fly, how much time they have and how they move inside the terminal.

Digital transformation gives airports new ways to understand passenger behavior and to respond to it. AI can process large amounts of data and turn them into commercial information for passenger analytics, demand forecasting, personalized marketing, inventory planning, pricing, passenger-flow analysis and customer engagement (Ahamed, 2025). These tools fit airport retail well, but they must be adapted to its conditions: passengers have limited time, come from many countries and go through security checks, and demand changes with the flight schedule.

With AI, airport retail can become predictive rather than reactive. Machine learning can improve demand forecasts by capturing patterns that traditional methods miss (Mediavilla et al., 2022), and AI-based personalization can deliver targeted offers through airport apps, digital screens, online shops and pre-trip messages.

There are also difficulties. Airports and concessionaires often keep their data in separate systems, and personalization raises questions of privacy, transparency and passenger trust. Using AI in airport retail therefore requires data governance, cooperation between partners and clear performance indicators.

In this paper we study how AI can improve airport retail management and increase non-aeronautical revenue. We argue that AI is not just a new technology, but a management tool that can improve decisions along the whole airport retail value chain. The focus is on the link between AI capabilities and retail profitability indicators. Evidence from the Albanian market supports this focus. Loyalty-card programs and customized benefits have been shown to influence customer behavior (Myftaraj & Trebicka, 2023), and customer satisfaction can be explained by measurable service and behavioral factors that managers can identify with data (Kullolli et al., 2024).

The contribution of the paper can be understood against three streams of research. Studies of airport commercial revenue identify the determinants of non-aeronautical income, such as traffic volume, the share of international passengers, passenger and flight characteristics and dwell time (Castillo-Manzano, 2010; Choi & Park, 2022; Fasone et al., 2016; Wu et al., 2024), but they treat these factors as given conditions rather than as information that managers can act upon. Studies of AI in retail and marketing explain how machine learning, recommendation systems and forecasting create value (Ahamed, 2025; Huang & Rust, 2021; Mediavilla et al., 2022), but they usually assume repeat customers, flexible store formats and data held by a single retailer, which is rarely the case at airports. Studies of smart airports focus mainly on operations, security and passenger processing (Tan & Masood, 2021). The framework proposed here differs from these streams in three ways: (1) it links specific data inputs, AI applications, retail decisions and profitability indicators in one explicit chain; (2) it identifies the airport-specific conditions that moderate these links, namely dwell time, flight-schedule-driven demand, one-off passenger encounters, concession contracts and data sharing between the airport operator and its concessionaires; and (3) it states the links as propositions that can be tested, together with their limitations and the metrics needed to verify them.

The framework is illustrated with the case of Tirana International Airport (TIA), the main international gateway of Albania. Traffic at TIA rose from 7.26 million passengers in 2023 to more than 11.6 million in 2025 (Tirana International Airport, 2024a, 2025), and a new duty-free operator took over the airport's retail concession in January 2025 (Noor, 2025). This combination of rapid growth and commercial reorganization makes the airport a useful setting for asking how growing traffic can be turned into more retail value per passenger.

The research questions of this paper are as follows:

RQ1: How can artificial intelligence improve airport retail management and profitability?

RQ2: Which AI-based tools are most relevant for enhancing airport retail profitability?

RQ3: How can passenger growth be transformed into higher retail revenue through AI-supported decision-making?

RQ4: What are the main challenges of implementing AI-based retail strategies in airport commercial management?

The remainder of the paper is organized as follows. Section 2 reviews the literature, Section 3 describes the review and analysis procedure, Section 4 presents the analytical findings and the framework and assesses its links critically, Section 5 discusses the framework in relation to previous studies, and Section 6 concludes.

2. Literature Review

2.1 Airport Retail and Non-Aeronautical Revenue

The airport business model has changed substantially in recent decades. Airports are no longer seen only as transport infrastructure, but also as commercial platforms where aeronautical and non-aeronautical activities work together to keep the airport financially healthy. Aeronautical revenue usually includes landing fees, passenger charges, aircraft parking and other airline-related income. Non-aeronautical revenue includes retail, duty-free, food and beverage, car parking, advertising, lounges, real estate and other commercial services. Graham (2014) explains that non-aeronautical revenue has become a central part of airport management, because it helps airports diversify income and depend less on airlines. Retail is one of the most important parts of non-aeronautical revenue, because it turns passenger movement and waiting time into commercial value. Freathy and O'Connell (1998) describe how airport retailing grew together with airports themselves, with international passenger flows and with the commercialization of terminals. More recent work confirms that airports are under pressure to raise non-aeronautical income, since aeronautical revenue alone is often not enough to cover long-term investment and operating costs (Akoodie & Cloete, 2020).

The role of non-aeronautical revenue became even clearer after the COVID-19 pandemic. As traffic recovered, airports looked for more stable sources of income, and retail was one of the main ones. Li et al. (2024) study how air travelers shop and what this means for non-aeronautical revenue in different countries, showing that retail is an important part of the airport revenue mix. Airport retail is therefore not a side activity, but a strategic part of airport business development.

Retail profit, however, depends on how well the airport turns traffic into spending, not only on passenger numbers. Performance should therefore be measured with indicators such as sales per passenger, conversion rate, average transaction value, retail revenue per square meter, inventory turnover and concession revenue. Sales per passenger is particularly useful because it is the product of the number of transactions per passenger (the conversion or penetration rate) and the average transaction value, so it shows whether a change in revenue comes from more buyers or from larger baskets.

2.2 Passenger Behavior in Airport Retail

Passenger behavior is a key topic in airport retail research. Shopping at an airport is different from shopping in a city, because it happens in a controlled and time-limited setting that is linked to travel. Security checks, boarding time, destination, purpose of the trip, baggage limits, mood and available time all affect what passengers do. Lin and Chen (2013) found that shopping motivation, impulse buying tendency and time pressure all shape airport shopping behavior. Their results suggest that passengers buy more when shopping is easy, pleasant and connected to their travel needs.

Dwell time is especially important. It is the time passengers spend in the terminal after check-in and security and before boarding. Using data from 89 U.S. airports, Wu et al. (2024) found that longer dwell time increases non-aeronautical revenue: a 10% increase in dwell time is linked to about a 5% increase in non-aeronautical revenue, with larger effects for food and beverage (about 8%) and retail (about 6%). This shows that operations and commercial results are closely connected. When passengers get through the airport processes quickly and have relaxed time before boarding, they are more likely to shop or eat.

Passenger and flight characteristics also matter. Choi and Park (2022), using duty-free transaction data from Incheon International Airport, found that these characteristics affect both the share of buyers and the spending per flight. Retail income therefore changes with destination, passenger profile, type of travel, nationality, time of day and route. For example, international passengers may be more likely to buy duty-free products, business travelers may prefer fast and premium services, and leisure travelers may respond better to gifts, souvenirs, cosmetics, perfumes and bundle offers.

These studies show that airport retail needs better segmentation than traditional mass marketing. Airports need to know who their passengers are, where they are going, how much time they have, what they are likely to buy and which channels reach them. Research from Albania points in the same direction. Kullolli et al. (2024) show that customer satisfaction can be explained through measurable factors, and Myftaraj and Trebicka (2023) show that loyalty cards and customized benefits influence customer behavior. Harizi et al. (2023) also show that shopping decisions depend on product attributes, the situation and personal preferences, which supports a more detailed segmentation of customers. All of this is relevant for airports, because AI-based passenger analytics and personal offers also depend on understanding what customers want and how they react.

2.3 Artificial Intelligence in Retail Management

AI has become a major force in retail management. The term refers to technologies that let systems perform tasks that usually need human intelligence, such as learning, prediction, pattern recognition, language processing and decision support. In retail, AI is used for customer segmentation, product recommendations, predictive analytics, demand forecasting, inventory optimization, pricing, chatbots, computer vision and automated customer service.

Ahamed (2025) argues that AI is changing retail by improving both the customer experience and operational decisions. AI allows retailers to analyze large amounts of customer data and find patterns that are hard to see with traditional methods. This leads to more personal marketing, better product recommendations, stronger customer engagement and more efficient operations.

Demand forecasting is one of the most useful applications of AI in retail. Traditional forecasting relies mostly on past sales and often misses quick changes in consumer behavior, seasonality, market shocks or outside factors. Mediavilla et al. (2022) reviewed AI methods for demand forecasting in supply chains and concluded that they can improve accuracy by finding complex patterns in large data sets. This is especially relevant for airport retail, where demand changes with flight schedules, season, passenger nationality, type of route, holidays and tourism flows.

AI is also useful for inventory management. At airports, small shops, high rents, strict logistics and security rules and quickly changing passenger flows make stockouts and overstocking particularly costly, and AI-based systems can predict demand and automate reordering.

2.4 Artificial Intelligence in Airport Management

Airports have adopted many digital technologies as part of becoming smart airports. AI and other Industry 4.0 technologies are used in operations, passenger-flow management, baggage handling, biometric identification, predictive maintenance, security screening, queue management and customer service. Tan and Masood (2021) explain that these technologies can help airports work more efficiently, improve the passenger experience, generate ancillary revenue and get more capacity out of existing infrastructure.

Most research on AI at airports focuses on operations and security, but the same tools are also useful for retail. Passenger-flow analytics, computer vision, mobile app data, Wi-Fi analytics, sensors and flight information systems can show how passengers move through the terminal, where they stop, which retail areas attract them and where sales opportunities are lost. This information can guide store location, product placement, digital advertising, staffing and promotion planning.

AI can also make the passenger experience more personal. An airport app can suggest shops or offers based on the passenger's destination, boarding time and position in the terminal, showing shopping and dining options to passengers with a long wait and fast services or click-and-collect to those with little time. In this way, AI links operational data with commercial decisions.

2.5 AI and Airport Retail Profitability

AI can improve airport retail profitability through four main mechanisms. First, it can raise conversion rates by identifying the passenger groups most likely to buy and showing them more relevant offers. Second, it can increase average transaction value through recommendations, bundles, cross-selling and suggestions of premium products based on passenger profile, destination and dwell time. Third, it can increase sales per passenger by improving the timing, channel and content of retail communication before security, after security and near the gate; these channels work best as part of an integrated marketing communication strategy with a consistent message across all touchpoints (Harizi & Trebicka, 2023). Fourth, it can improve inventory turnover and reduce costs through demand forecasting and automatic replenishment. AI therefore supports profitability on both the revenue side and the cost side.

2.6 Challenges of AI Implementation in Airport Retail

AI also brings challenges. The first is fragmented data: airport operators, airlines, duty-free companies, food and beverage operators and technology firms each store data in their own systems, which makes it hard to combine passenger, flight, sales and inventory information. The second is privacy and trust: personalization depends on data about behavior, location, purchases and travel, and research on online behavioral advertising shows that trust,

transparency and privacy concerns strongly shape how users respond to personalized communication (Hasrama et al., 2024). The third is cost and organizational readiness, since AI requires infrastructure, system integration, skilled staff and managers who can turn its results into decisions. Finally, AI raises ethical and legal concerns, including algorithmic bias, excessive surveillance and lack of transparency.

2.7 Literature Gap

The literature offers useful insights on non-aeronautical revenue, passenger shopping behavior, dwell time, AI in retail and digital transformation at airports, but these streams have developed largely in parallel. Research on airport commercial revenue explains which factors are associated with higher non-aeronautical income (Castillo-Manzano, 2010; Fasone et al., 2016; Wu et al., 2024) without examining how managers can use data on these factors to make better retail decisions. Research on AI in retail shows the value of prediction and personalization (Ahamed, 2025; Huang & Rust, 2021), but it rarely considers the constraints of airport retail: short and uncertain dwell time, one-off encounters with passengers, demand driven by the flight schedule, fixed terminal layouts, concession contracts and data spread across several organizations. Research on smart airports applies AI mainly to operations (Tan & Masood, 2021). As a result, there is no framework that explains, link by link, how AI applications can affect airport retail profitability indicators, under which conditions, and how such effects could be verified. This paper addresses this gap.

3. Methodology

3.1 Research Design

This study uses a conceptual design based on an integrative literature review (Snyder, 2019). Following the theory-synthesis approach to conceptual articles (Jaakkola, 2020), it brings together research on airport retail, non-aeronautical revenue, passenger behavior and AI in retail into a framework for airport retail profitability, and it uses Tirana International Airport as an illustrative case. Instead of measuring the direct financial effect of AI, the paper proposes a structured management framework that explains how AI tools can support retail profitability and under which conditions these effects can be expected.

A conceptual approach is suitable for new research areas where theory is still being developed. AI in airport retail is such an area, and there is still little empirical research that links AI tools directly to airport retail indicators. The study therefore focuses on the main mechanisms, the managerial implications and directions for future research.

3.2 Case Selection and Use of Case Evidence

Tirana International Airport was selected as an illustrative case for three reasons. First, its operator describes it as the fastest-growing airport in Europe since the pandemic (Tirana International Airport, 2024b), so the question of how to turn traffic growth into retail value is especially pressing. Second, it is the main air gateway to Albania, which makes its passenger mix strongly shaped by tourism and seasonality. Third, its duty-free concession changed hands in January 2025 and the terminal is being expanded (Noor, 2025; Tirana International Airport, 2024b), so decisions on retail layout, data sharing and digital tools are being taken now.

The case is used to illustrate the framework, not to test it. To keep the two apart, the paper distinguishes between contextual evidence and analytical propositions. Contextual evidence consists only of facts reported in dated public sources, such as the airport's traffic reports and press releases and trade-press reports on the duty-free concession, and it is cited as such. Analytical propositions are the authors' inferences about how AI could affect retail performance at the airport; they are derived from the literature and the framework and are presented as propositions to be tested, not as empirical results. Retail turnover, conversion rates and other commercial indicators for TIA are not publicly available and are therefore not reported.

3.3 Research Approach

The study follows an exploratory qualitative approach based on secondary data. It does not test causal relationships statistically, because retail transaction data from Tirana International Airport are confidential and not publicly available.

3.4 Data Collection

The study uses secondary data from three sources. The first and main source is the academic literature. Sources were selected with four criteria: (1) relevance to at least one of the four thematic blocks of the study, namely airport non-aeronautical revenue and commercial management, passenger shopping behavior and dwell time, AI in retail and marketing, and AI and digital technologies at airports; (2) publication in a peer-reviewed journal, a scholarly book or an authoritative institutional source; (3) publication in English; and (4) publication between 1998 and 2026, with priority given to studies published after 2010, when research on airport commercial revenue and on AI in retail expanded. Earlier seminal works (e.g., Freathy & O'Connell, 1998) were retained because they define core concepts. Studies of airport finance that did not address commercial or retail activities, and technical AI studies without a managerial application, were excluded.

The second source is public information about Tirana International Airport: the air traffic report for 2025 and the airport's market statistics page (Tirana International Airport, 2025, n.d.), and the operator's press releases on annual traffic, routes and terminal investment (Tirana International Airport, 2024a, 2024b). These sources are used only as contextual evidence on the case.

The third source is industry and institutional publications, including ACI World and ICAO material on airport economics and non-aeronautical revenue (Cheglatonyev, 2025; ICAO, n.d.) and trade-press reports on the airport's duty-free concession (Noor, 2025).

3.5 Data Analysis

The material was analyzed with qualitative content analysis, following the logic of framework analysis, in four steps. First, an initial coding frame was derived deductively from the research questions, with four categories: AI capabilities, retail management decisions, profitability indicators and implementation conditions. Second, the relevant passages of each source were coded into these categories, and new codes were added inductively when a source raised an issue not covered by the initial frame, for example dwell time, flight-level demand patterns or consent to the use of data. Third, the codes were grouped into themes by comparing them across sources and across the research streams. Fourth, the themes were charted in a matrix that links each theme to its main sources and to the element of the framework it informs (Table 1). This matrix was then used to build the framework and the propositions presented in Section 4.

Table 1. Thematic Coding Frame and Its Link to the Framework

Theme	Main sources	Role in the framework
Non-aeronautical revenue and its determinants	Akoodie & Cloete (2020); Castillo-Manzano (2010); Fasone et al. (2016); Graham (2014); Li et al. (2024); ICAO (n.d.)	Defines the profitability outcomes and the commercial context
Passenger and flight characteristics	Choi & Park (2022); Lin & Chen (2013); Harizi et al. (2023)	Data inputs for segmentation and demand forecasting
Dwell time and passenger flow	Wu et al. (2024); Tan & Masood (2021)	Data inputs for the timing and location of offers; moderating condition
AI capabilities in retail and marketing	Ahamed (2025); Huang & Rust (2021); Mediavilla et al. (2022)	AI applications and their mechanisms
Personalization, loyalty and digital communication	Harizi & Trebicka (2023); Kullolli et al. (2024); Myftaraj & Trebicka (2023); Tartaraj et al. (2024)	Retail decisions on offers and channels; customer satisfaction
Privacy, trust and data governance	Hasrama et al. (2024)	Implementation condition and risk
Organizational AI capability	Mikalef & Gupta (2021)	Implementation condition (complementary resources and skills)

This analysis led to an AI-based framework for airport retail profitability that links data inputs and AI capabilities to retail management decisions and profitability outcomes. AI capabilities include passenger analytics, recommendation systems, demand forecasting, inventory optimization, passenger-flow analytics and digital engagement tools. Retail management decisions include product assortment, personalized promotions, store layout, pricing, stock planning and timing of communication. Profitability outcomes include conversion rate, average transaction value, sales per passenger, retail revenue per square meter, inventory turnover, customer satisfaction and concession revenue.

3.6 Validity, Reliability, and Limitations

Validity is supported by triangulation, since the study combines academic literature, airport information and industry sources. Using different types of secondary evidence gives a broader view of how AI can support retail profitability. Reliability is supported by a documented procedure: the selection criteria, the coding frame and the resulting themes are reported (Table 1), so that the analysis can be traced and repeated.

The main limitations of this design, namely the reliance on secondary data, the use of a single illustrative case and the absence of primary data, are discussed in Section 6.6.

4. Analytical Findings

4.1 Overview of the Case Study Results

The findings are organized around the four research questions. Because detailed internal sales data from Tirana International Airport are not public, they are based on the literature, the framework and public information on the airport. Two types of statements are therefore kept apart: contextual evidence, which reports sourced facts about the airport (Section 4.2 and Table 2), and analytical propositions, which are the authors' inferences about how AI could affect retail performance and should be read as propositions for testing, not as measured results.

4.2 Contextual Evidence and Analytical Propositions for Tirana International Airport

Passenger traffic at TIA has grown rapidly. The airport handled 7,257,634 passengers in 2023, 40% more than in 2022 and 117% more than in 2019 (Tirana International Airport, 2024a), passed 10 million passengers before the end of 2024 (Tirana International Airport, 2024b) and handled 11,640,044 passengers in 2025, 9% more than in 2024 (Tirana International Airport, 2025). Traffic is highly seasonal: in 2025 the months from June to September accounted for about 43% of annual passengers, with a peak of 1,413,064 passengers in August compared with 632,314 in February (Tirana International Airport, 2025). At the end of 2024 the airport served more than 129 direct destinations and was expanding its terminal, and, according to the operator, about 10 million of the 11.04 million visitors who came to Albania in the first eleven months of 2024 arrived through the airport (Tirana International Airport, 2024b). On the commercial side, Lagardère Travel Retail took over the airport's duty-free operations as the sole operator in January 2025 and planned to refurbish the existing store from March 2025 (Noor, 2025).

These facts describe the context; they do not show how much of the traffic is converted into retail sales. Retail turnover, conversion rates, average transaction values and sales per passenger at TIA are not published. Table 2 therefore separates the contextual evidence from the analytical propositions that the paper derives from it.

Table 2. Contextual Evidence and Analytical Propositions for Tirana International Airport

Contextual evidence (source)	Analytical proposition (to be tested)
Traffic rose from 7.26 million passengers in 2023 to 11.64 million in 2025 (Tirana International Airport, 2024a, 2025).	Growth enlarges the potential customer base, but sales per passenger may fall if commercial space, staff and stock do not grow with traffic; sales per passenger, not total sales, shows whether growth is converted into retail value.
June to September accounted for about 43% of passengers in 2025; August had 1.41 million passengers and February 0.63 million (Tirana International Airport, 2025).	Strong seasonality makes demand forecasting and staff planning by month, week and flight bank the AI applications with the clearest business case.
More than 129 direct destinations at the end of 2024 (Tirana International Airport, 2024b).	Route expansion increases the value of route-level segmentation but creates a cold-start problem: new routes have no sales history, so forecasts must rely on comparable routes.
About 10 million of the 11.04 million visitors to Albania in January–November 2024 arrived through the airport (Tirana International Airport, 2024b).	A tourism-driven passenger mix suggests demand for local products, gifts and souvenirs in the departure area, which can be targeted by route where data allow.
Lagardère Travel Retail became the sole duty-free operator in January 2025, with store refurbishment from March 2025; the terminal is being expanded (Noor,	A new concession and terminal expansion create a window to include data-sharing clauses, shared performance indicators and flow-based layout decisions in contracts and design.

Contextual evidence (source)	Analytical proposition (to be tested)
2025; Tirana International Airport, 2024b).	
Retail turnover, conversion and transaction data are not publicly available.	The profitability effects of AI at TIA cannot be measured from public data; testing the framework requires data-sharing agreements with the operator and concessionaires.

The propositions in Table 2 suggest that, at TIA, the main retail question is not how to attract more passengers but how to keep sales per passenger from falling as traffic grows, and how to match stock, staff and offers to a highly seasonal and changing route network. The following sections address this question through the four research questions.

4.3 Results Related to RQ1: How Can Artificial Intelligence Improve Airport Retail Management at Tirana International Airport?

The first research question asks how AI can improve airport retail management at Tirana International Airport. The findings suggest that AI can support better decisions on passenger segmentation, demand forecasting, product placement, inventory planning, promotions and customer engagement.

Today, decisions in airport retail often rely on past sales, total passenger traffic, store location and supplier experience. AI can improve this by using both real-time and historical data to predict passenger behavior more accurately. For example, it can combine traffic data, flight schedules, destinations, seasonal trends and purchase behavior to show which products should be promoted and stocked at specific times.

At Tirana International Airport, AI could help managers answer practical questions such as:

- Which passenger groups are most likely to buy duty-free products?
- Which destinations generate higher demand for cosmetics, perfumes, local products, or premium goods?
- Which time periods create the highest retail potential?
- Which stores or product categories are underperforming?
- How can retail offers be personalized according to passenger profile and dwell time?

Table 3. AI Contributions to Airport Retail Management at Tirana International Airport

Airport retail management area	Current challenge	AI-based improvement
Passenger segmentation	Passengers may be treated as one general group	AI can segment passengers by destination, travel purpose, nationality, season, dwell time, and purchase behavior
Demand forecasting	Demand may fluctuate by route, season, and passenger profile	AI can predict product demand based on flight schedules and historical purchasing patterns
Inventory management	Risk of stockouts or overstocking	AI can optimize replenishment and reduce inventory inefficiencies
Store layout and product placement	Product visibility may not match passenger-flow patterns	AI and computer vision can identify high-traffic zones and improve product positioning
Personalized promotion	Generic promotions may have low conversion	AI can deliver targeted offers through apps, digital screens, or email
Staffing decisions	Retail staffing may not match passenger peaks	AI can predict busy periods and support better staff allocation
Customer engagement	Limited interaction with passengers before purchase	AI chatbots, airport apps, and recommendation systems can guide passengers to relevant offers

The answer to RQ1 is that AI can help Tirana International Airport move retail decisions from a traditional, reactive model to a predictive, personalized and data-driven one.

4.4 Results Related to RQ2: Which AI-Based Tools Are Most Relevant for Increasing Airport Retail Profitability at Tirana International Airport?

The second research question asks which AI tools matter most for retail profitability. Not all tools are equally important. For Tirana International Airport, the most relevant are those that directly affect conversion rate, average transaction

value, sales per passenger, inventory turnover and customer satisfaction.

The tools with the highest priority are passenger analytics, demand forecasting, inventory optimization and recommendation systems, followed by digital promotion management, passenger-flow analytics and click-and-collect tools. The priority levels in Table 4 are the authors' assessment, based on three criteria: how directly a tool affects a profitability indicator, whether the data it needs are likely to be available, and how complex it is to implement. They are not measured effects.

Table 4. Priority AI Tools for Airport Retail Profitability at Tirana International Airport

AI tool	Main function	Expected profitability effect	Priority level
Passenger analytics	Analyzes passenger profiles, routes, time patterns, and behavior	Improves segmentation and targeting	Very high
AI demand forecasting	Predicts product demand by season, route, and passenger flow	Reduces stockouts and overstocking	Very high
AI inventory optimization	Automates replenishment and product availability decisions	Improves inventory turnover	Very high
Recommendation systems	Suggests relevant products and offers	Increases conversion rate and basket size	Very high
Digital promotion management	Sends targeted offers through apps, screens, QR codes, or email	Increases offer relevance and sales per passenger	High
Passenger-flow analytics	Tracks movement patterns and commercial-zone performance	Improves store layout and product placement	High
Click-and-collect AI tools	Supports pre-order and airport pickup	Captures sales before airport arrival	High
Computer vision	Identifies traffic density, queues, and attention zones	Supports layout, staffing, and queue management	Medium-high
Chatbots and virtual assistants	Provides retail guidance, product information, and service support	Improves customer experience	Medium
Dynamic pricing support	Supports promotion timing and discount decisions	Improves margin and reduces unnecessary discounts	Medium

The answer to RQ2 is therefore that the tools with the clearest link to profitability are those that combine passenger and flight data with sales data, namely passenger analytics, demand forecasting, inventory optimization and recommendation systems, while tools that depend on passenger opt-in or new infrastructure, such as personalized app offers, computer vision and dynamic pricing, are better introduced later.

4.5 Results Related to RQ3: How Can Passenger Growth at Tirana International Airport Be Transformed into Higher Retail Revenue Through AI-Supported Decision-Making?

The third research question asks how passenger growth can become higher retail revenue. The analysis suggests that this depends on the whole process that turns a passenger into a customer.

The conversion process can be explained as follows:

Passenger traffic → Passenger segmentation → Personalized offer → Store visit or digital purchase → Transaction → Higher retail revenue

Table 5. AI-Supported Passenger-to-Revenue Conversion Model

Stage	AI role	Retail outcome
Passenger arrives at airport	AI identifies flight, time, destination, and passenger-flow pattern	Passenger becomes a measurable retail opportunity
Passenger completes airport procedures	AI estimates dwell time and movement pattern	Airport identifies shopping window
Passenger enters commercial area	AI recommends relevant products or stores	Higher probability of store visit
Passenger receives offer	AI personalizes promotion by profile and context	Higher conversion rate
Passenger purchases	AI supports cross-selling and product bundling	Higher average transaction value
Retail data are analyzed	AI learns from transaction patterns	Better future decisions

Each stage of this model is a point where the conversion can fail, and each therefore needs its own indicator, such as the share of passengers who enter a store, the conversion rate and the average transaction value. Measuring the stages separately shows where AI adds value and where it does not.

The answer to RQ3 is that passenger growth at Tirana International Airport can bring higher retail revenue if AI is used to raise conversion rates, make offers more relevant, optimize inventory and increase average transaction value.

4.6 Results Related to RQ4: What Are the Main Challenges of Implementing AI-Based Retail Strategies at Tirana International Airport?

The fourth research question looks at the challenges of using AI. The analysis points to several barriers: fragmented data, limited access to sales data, privacy concerns, investment costs, coordination between stakeholders, technical skills and organizational readiness.

Airport retail involves many actors, each holding different data; without data sharing between the airport and its concessionaires, AI cannot give a complete and accurate picture. Personalization also requires passenger data, so any AI-based retail strategy must be built on transparency, consent, anonymization and strong data governance.

Table 6. Main Challenges of AI Implementation at Tirana International Airport

Challenge	Explanation	Possible solution
Data fragmentation	Airport, airlines, duty-free operators, and retailers may hold separate data	Create a shared commercial data platform
Limited retail data access	Detailed transaction data may not be publicly available or shared	Establish data-sharing agreements with concessionaires
Privacy concerns	Passengers may resist personalized tracking or offers	Use anonymized data, consent-based apps, and transparent privacy rules
Investment cost	AI systems require software, infrastructure, and skilled employees	Start with pilot projects and scalable tools
Technical expertise	Airport retail teams may lack AI and analytics skills	Train staff and cooperate with technology providers
Organizational readiness	Managers may not use AI insights in decision-making	Integrate AI outputs into commercial planning processes
Stakeholder coordination	Airport and concessionaires may have different priorities	Create joint performance indicators and shared retail goals
Cybersecurity risk	Passenger and commercial data must be protected	Apply strong cybersecurity and data-protection standards

The answer to RQ4 is that AI is feasible at Tirana International Airport, but it requires data integration, cooperation between stakeholders, privacy protection, investment planning and stronger organizational capacity.

4.7 Proposed AI-Based Retail Profitability Framework for Tirana International Airport

Based on these results, we propose an AI-based retail profitability framework for Tirana International Airport. Table 7 shows its three levels: data inputs, AI applications and profitability outcomes. The retail decisions through which each application acts, such as assortment, stock, promotion, layout and timing, are described in Table 3.

Table 7. AI-Based Retail Profitability Framework for Tirana International Airport

Data inputs	AI applications	Profitability outcomes
Passenger traffic data	Passenger analytics	Higher conversion rate
Flight schedules	Demand forecasting	Higher sales per passenger
Route and destination data	Product recommendation systems	Higher average transaction value
Retail transaction data	Inventory optimization	Better inventory turnover
Passenger-flow data	Store layout optimization	Higher retail revenue per square meter
App and digital interaction data	Personalized promotions	Higher customer satisfaction
Seasonal and tourism data	Promotion timing and campaign planning	Higher concession revenue

The framework shows that AI creates value when data are turned into decisions and decisions are turned into measurable retail results. For Tirana International Airport, the biggest potential lies in using passenger and flight data to improve product availability, personalize offers, raise conversion and increase the value created by each passenger. These links are, however, propositions rather than demonstrated effects; Section 4.8 examines them critically.

4.8 Critical Assessment of the Links Between AI Applications and Profitability Indicators

The links in Table 7 are plausible, but the evidence behind them is uneven. The literature directly supports the determinants on which the framework builds: longer dwell time is associated with higher non-aeronautical revenue (Wu et al., 2024), passenger and flight characteristics affect the share of buyers and spending per flight (Choi & Park, 2022), and machine learning can improve demand forecasts (Mediavilla et al., 2022). Evidence that AI applications raise airport retail indicators, however, is still scarce and comes mainly from general retail, where customers can be identified and return repeatedly. The links should therefore be treated as propositions whose strength depends on several conditions.

Four conditions are especially important. First, data: forecasts and segmentation require sales data that can be linked to flights, which is possible only if the airport and its concessionaires share data and if flight information is captured at the point of sale. Second, reach: most passengers are met only once and only some of them use an airport app or loyalty program, so individual personalization can reach only part of the passengers, while decisions on stock, staffing and offers at the level of flights and routes apply to all of them. Third, physical and contractual flexibility: store layout, space and assortment are fixed for long periods by terminal design and concession contracts, which limits how quickly AI insights can be acted upon. Fourth, incentives: when concession fees depend on sales, both the airport and the retailer gain from higher sales per passenger, whereas fixed rents weaken the airport's incentive to invest in shared analytics.

There are also limits to what AI can achieve. Changes in sales per passenger may reflect changes in the traffic mix, for example more leisure or international passengers in summer, rather than the effect of AI, so effects can only be attributed through controlled comparisons, such as A/B tests of offers or before-and-after comparisons with control flights, periods or zones. New routes have no sales history, which limits forecast accuracy where growth is fastest. Personalization raises privacy and trust concerns that can reduce acceptance (Hasrama et al., 2024), and the benefits of AI depend on complementary resources such as data governance, skills and the managerial use of results (Mikalef & Gupta, 2021). Table 8 summarizes the mechanism, conditions, limitations and verification metric for each main link.

Table 8. Critical Assessment of the Main AI–Profitability Links

Proposed link	Mechanism	Main conditions	Limitations and risks	How to verify
Passenger analytics → conversion rate	Identifies flights and segments with a high propensity to buy	Sales linked to flights; shared operator–concessionaire data	Changes in traffic mix can be mistaken for AI effects; small segments	Conversion by flight compared with control flights
Demand forecasting and inventory optimization → inventory turnover, fewer stockouts	Anticipates demand by route, season and flight bank	Item-level sales history; reliable schedule data	No history for new routes; supplier lead times; demand shocks	Forecast error, stockout rate, inventory turnover
Recommendations and personalized offers → average transaction value	Shows relevant products at the right moment	Opt-in channels (app, Wi-Fi, loyalty); passenger consent	Limited reach; privacy concerns; one-off encounters	A/B tests; transaction value of treated vs. control groups
Dwell-time-based timing of offers → sales per passenger	Uses predicted time before boarding to time offers	Real-time security-queue and gate data	Delays and gate changes; message fatigue	Sales per passenger by dwell-time band
Passenger-flow analytics → revenue per square meter	Aligns store location and product placement with passenger flows	Sensors or computer vision; layout flexibility in contracts	Fixed layouts; privacy of video data; cost	Revenue per square meter before and after, with control zones
Click-and-collect and pre-order → sales per passenger	Captures demand before the passenger reaches the airport	Integrated online shop and pickup logistics	May shift rather than add sales	Incremental sales net of in-store substitution

4.9 Proposed Implementation Roadmap

The results also suggest that AI should be introduced gradually. The airport does not need to adopt all tools at once. A phased plan lowers the risk and lets the airport test the commercial effect of AI before investing more.

Table 9. Proposed AI Implementation Roadmap for Tirana International Airport

Phase	AI action	Expected result
Phase 1: Data preparation	Collect and integrate passenger traffic, flight, retail, and concession data	Better commercial visibility
Phase 2: Passenger analytics	Segment passengers by destination, travel purpose, season, and dwell time	More accurate retail targeting
Phase 3: Demand forecasting	Predict product demand by route and season	Better stock planning
Phase 4: Personalized offers	Use airport apps, digital screens, QR codes, or email campaigns	Higher conversion rate
Phase 5: Inventory optimization	Automate replenishment and stock-level decisions	Lower stockouts and overstocking
Phase 6: Performance measurement	Track sales per passenger, conversion rate, average transaction value, and customer satisfaction	Evidence-based retail strategy

4.10 Managerial Implications

The findings have several implications for airport operators, concessionaires, duty-free retailers and commercial managers. First, airports should judge retail performance by sales per departing passenger and its components, conversion rate and average transaction value, as well as by retail revenue per square meter and inventory turnover, and not only by total revenue, which rises with traffic even when performance per passenger declines.

Second, concessionaires and airport operators should share data more closely. Retail profitability depends on connecting passenger traffic, flight schedules, routes, sales, product categories and concession performance. Without this cooperation, AI cannot produce accurate insights. Airports should include data-sharing agreements in concession contracts that state what data will be shared, how often, how it will be protected and how it will be used. These agreements should cover aggregated and anonymized commercial data, not personal passenger information.

Third, airports should start with passenger analytics and demand forecasting, which rely mainly on flight and sales data already held by the airport and its concessionaires and provide the basis for more advanced applications.

Fourth, airports should make more use of digital promotions and click-and-collect services, which allow passengers to browse and reserve products before they arrive and to pick them up after security, so that sales are captured even when time is short. Social media can also reach passengers before the trip: evidence from the Albanian market shows that influencer marketing on platforms such as TikTok affects consumer behavior (Tartaraj et al., 2024).

Finally, data governance and passenger privacy should be part of every AI-based retail strategy, through clear privacy rules, anonymization, cybersecurity standards and transparent consent options.

5. Discussion

5.1 Comparison with Previous Studies

The framework is consistent with studies of the determinants of non-aeronautical revenue, but it uses their results in a different way. Castillo-Manzano (2010) and Fasone et al. (2016) relate commercial revenue to factors such as traffic volume and passenger characteristics, Choi and Park (2022) show that passenger and flight characteristics affect the share of buyers and spending per flight, and Wu et al. (2024) find that longer dwell time is associated with higher retail and food and beverage revenue. In these studies the determinants are explanatory variables. In the proposed framework they become inputs for decisions: flight and passenger characteristics feed route-level forecasting and segmentation, and predicted dwell time determines the timing and location of offers. The framework thus moves from explaining differences in commercial revenue to managing them.

Compared with research on AI in retail and marketing (Ahamed, 2025; Huang & Rust, 2021; Mediavilla et al.,

2022), the framework emphasizes the conditions that make airport retail different: short and uncertain shopping time, one-off encounters with most customers, demand driven by the flight schedule, fixed space and concession contracts, and data held by several organizations. These conditions shift the main source of value from individual-level personalization, which dominates the general retail literature, to prediction at the level of flights and routes, which needs less personal data and is therefore also easier to reconcile with passengers' privacy concerns (Hasrama et al., 2024). Compared with the smart-airport literature, which applies AI mainly to operations and passenger processing (Tan & Masood, 2021), the framework shows that the same operational data, such as queue times, passenger flows and gate assignments, are also commercial inputs. Finally, in line with research on AI capability (Mikalef & Gupta, 2021), it treats data governance, skills and stakeholder coordination as conditions for value creation rather than as secondary implementation issues.

5.2 Theoretical Contribution

The paper makes three theoretical contributions. First, it specifies the chain from data inputs and AI applications to retail decisions and profitability indicators, which makes the relationships explicit and testable. Second, it identifies airport-specific moderators of these relationships, namely dwell time, flight-schedule-driven demand, one-off encounters, concession structure and data sharing, and thereby extends general models of AI in retail to a constrained commercial setting. Third, it makes the shift from a passenger-volume model to a passenger-value model measurable by decomposing sales per passenger into conversion rate and average transaction value.

Several propositions can be derived from the framework for future testing: (P1) route-level demand forecasting reduces stockouts and increases inventory turnover more at airports with strong seasonality and frequent route changes; (P2) offers timed by predicted dwell time increase sales per passenger more than untimed offers; (P3) the effect of personalization on average transaction value is limited by the share of passengers who can be reached through opt-in channels; and (P4) data sharing between the airport operator and its concessionaires is a precondition for the effects described in P1–P3.

5.3 Practical Contribution

In practical terms, the framework gives airport operators and concessionaires at fast-growing airports a sequence of decisions rather than a list of technologies: which data to integrate first, which applications to introduce, which indicators to monitor and how to test whether the effects are real (Tables 7–9). For airports such as TIA, where traffic, routes and the retail concession are changing at the same time, the main practical message is that the commercial benefits of growth depend on decisions taken now on data sharing, contract design and performance measurement. The managerial implications are set out in Section 4.10.

6. Conclusions

6.1 General Conclusion

This paper examined how AI can improve airport retail profitability and increase non-aeronautical revenue. Our main argument is that retail profit depends not only on passenger volume, but on how well airports and concessionaires turn passenger flows into commercial value. AI can help with this through passenger analytics, demand forecasting, personalized promotions, inventory optimization, passenger-flow analysis and digital customer engagement.

We developed a management framework that links AI capabilities with retail profitability indicators. The framework was illustrated with the case of Tirana International Airport, keeping sourced contextual evidence separate from analytical propositions, and its links were assessed critically in terms of conditions, limitations and verification metrics.

Overall, AI should be treated as a strategic management tool for airport commercial development, and not only as a technological innovation. With AI, airports can move from a passenger-volume model to a passenger-value model, provided that the data, contractual and organizational conditions identified in this paper are in place.

6.2 RQ1: AI and Airport Retail Management

AI can make commercial decisions in airport retail more predictive, personal and data-driven by analyzing passenger behavior, flight schedules, destinations, dwell time, product demand and retail results together.

6.3 RQ2: Priority AI Tools

The AI tools with the clearest link to airport retail profitability are passenger analytics, demand forecasting, inventory optimization and recommendation systems, followed by digital promotion management and passenger-flow analytics. They are directly linked to the main goals of airport retail: higher conversion rates, higher sales per passenger, higher average transaction value, less waste in inventory and more satisfied customers.

6.4 RQ3: From Passenger Growth to Retail Revenue

Passenger growth turns into higher retail revenue only when the airport increases the value created by each passenger. AI supports this conversion by improving segmentation, personalizing offers, keeping products available and finding the best time and channel for communication.

6.5 RQ4: Implementation Challenges

The main challenges are fragmented data, limited access to sales data, privacy concerns, investment costs, technical capacity, stakeholder coordination and organizational readiness. Successful use of AI therefore requires cooperation and clear rules for data sharing between the airport and its concessionaires.

7. Limitations and Future Research

The study has three main limitations. First, it relies on secondary data and an analytical framework; confidential sales data from Tirana International Airport were not available, so the paper does not measure the financial impact of AI. Second, the links between AI applications and profitability indicators are derived from the literature and have not been tested empirically; the propositions in Section 5.2 and the verification metrics in Table 8 are intended to guide such tests. Third, the case evidence comes from public sources, mainly the airport operator's own reports and trade-press articles, and the use of one illustrative case limits generalization, although the framework may be useful for other fast-growing airports with similar challenges.

Future studies should test the framework and the propositions in Section 5.2 with primary data, such as passenger surveys, interviews with commercial managers and concessionaires, and detailed retail and route-level data, using methods such as regression analysis, structural equation modeling, machine learning or controlled field experiments.

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