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**Research Article**

# The Transformation of Airline Distribution: From Legacy Documents to Dynamic Retail Models

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**Abstract:**

The airline industry is undergoing a fundamental transformation in its distribution architecture, moving away from legacy document-based systems that have dominated commercial operations since the 1960s toward modern, offer-centric retail models. Traditional distribution relies on fragmented architectures that distribute commercial information across multiple independent documents including passenger name records, electronic tickets, and ancillary service documentation, creating operational inefficiencies and constraining commercial flexibility. This fragmentation limits airlines' ability to implement dynamic pricing, personalized offers, sophisticated bundling strategies, and real-time merchandising capabilities that are standard in contemporary digital commerce. The emerging paradigm introduces two core constructs: dynamic commercial propositions generated in real-time based on customer context and travel requirements, and unified commercial records that consolidate all transaction information into single authoritative sources throughout the customer journey. This transformation enables airlines to operate as sophisticated digital retailers capable of implementing continuous pricing strategies, customer-centric value optimization, and seamless omnichannel experiences. The shift represents more than technological modernization; it requires comprehensive organizational transformation including evolution of commercial teams from inventory managers to retail strategists, significant investment in analytical infrastructure and decision-support systems, and fundamental reconceptualization of revenue management from capacity-focused optimization to multidimensional value creation that balances immediate transaction revenue with long-term customer relationship development. Research demonstrates that modern distribution capabilities enable substantial improvements in operational efficiency, servicing simplification, merchandising effectiveness, and revenue capture through enhanced personalization, dynamic bundling, and ancillary service optimization across all distribution channels.

## 1. Introduction

The airline industry is at a turning point in its growth. For more than fifty years the distribution systems have used document based designs that were created in the computer era. The Passenger Name Record system started in the 1960s when the airlines first used computers to make the reservation processes automatic. The airlines used the reservation processes to handle the seat inventory and the passenger information across the route networks. I think the airline industry should look at ways for the distribution systems. I have worked with legacy frameworks. Legacy frameworks help the coordination and the operational reliability, for the hundreds of carriers and the thousands of travel agencies around the world. Legacy frameworks were built for the process environment and, for the agent, mediated bookings not for the consumer engagement. The technological foundation that came from those legacy frameworks created the protocols. The standardized protocols gave the aviation ecosystem interoperability. The standardized protocols let the airlines, the distribution intermediaries and the service providers connect through the systems. The centralized systems processed millions of transactions each day [1]. I notice that the rigid structure of reservation records, ticketing instruments and ancillary documentation shows the

limits of technology. In the days computers could not handle data so reservation records, ticketing instruments and ancillary documentation used very strict limited fields. Reservation records, ticketing instruments and ancillary documentation could be processed quickly on the mainframe systems. The mainframe systems had memory and low processing power. Because of the memory and low processing power, reservation records, ticketing instruments and ancillary documentation had to stay simple.Today's passengers want service, flexibility and clear pricing like they see on shopping sites. Online shopping sites give changing prices, up-to-date seat availability and smooth shopping across phone, web and app. Passengers now expect those things from airlines. The old legacy architecture splits one booking into papers such as booking records, e-tickets and extra service papers. The old legacy architecture does not match today's shopping expectations. That big gap has sparked a rethink of airline systems. Airline commercial systems now need to work like shops. I see that intermediary platforms dominate the distribution landscape. Intermediary platforms control a large share of the market and intermediary platforms impose limits on how airlines can show and price airlines products. Those limits reduce the ability of airlines to differentiate airlines offerings and to engage directly with customers in ways. The article that examines the impact of distribution standards on airline retailing reports that traditional distribution channels have limited airlines from using merchandising strategies, pricing models and product bundling that are common in other digital commerce sectors [2]. From what I see the industry is now moving from document systems to one unified offer based retail model. The industry places the carriers as sellers that can compete with travel sites. The industry lets the carriers meet changing customer demands through ways to talk to customers and better ways to show products [2]. This change is not a technology upgrade. This change is a shift in how airlines create, share and deliver business offers. The airlines apply the change, in a marketplace where customers want more and change quickly. The airlines face competition that forces the airlines to be more flexible and to improve retail.

## 2. The Architectural Constraints of Traditional Systems

The traditional distribution model distributes commercial information across multiple independent documents, creating a fragmented data architecture that has persisted for decades despite its operational inefficiencies. A single passenger journey generates separate records for reservation details, fare entitlements, ancillary services, and financial settlement, with each document type maintained in different systems that were never designed to communicate seamlessly with one another. This fragmentation creates inherent complexity in managing the customer relationship throughout the travel lifecycle, as information about a single transaction must be retrieved, validated, and synchronized across multiple databases and legacy platforms that operate with different update frequencies and data validation protocols. When circumstances change—whether through passenger-initiated modifications such as date changes, route alterations, or ancillary service additions, or through operational disruptions including flight cancellations, schedule changes, or equipment substitutions—reconciling information across disparate systems becomes operationally intensive and prone to inconsistency. The challenge of maintaining data coherence across multiple systems becomes particularly acute in complex passenger processing environments where real-time information synchronization is essential for operational effectiveness, yet legacy architectures lack the technical infrastructure to support seamless data exchange across interconnected platforms [3].

Beyond fragmentation, the legacy model imposes structural limitations on product design and pricing that fundamentally constrain airline commercial flexibility and revenue optimization capabilities. Airlines must conform their commercial strategies to predetermined classification systems and rule structures that prioritize system compatibility over customer value, effectively limiting innovation in product development and sophisticated merchandising approaches. Research examining the relationship between distribution capabilities and revenue management practices reveals that traditional architectures severely restrict airlines' ability to implement dynamic ancillary service strategies, which have become increasingly critical revenue streams representing substantial portions of total airline income. The rigid fare filing requirements and predefined booking class structures inherent in legacy systems prevent airlines from implementing real-time pricing adjustments based on demand signals, customer segmentation, or competitive dynamics [4]. This constraint manifests in reduced granularity for pricing decisions, where airlines are forced to aggregate diverse customer segments into broad fare classes rather than tailoring prices to individual willingness-to-pay or specific travel contexts that reflect actual market conditions. The limited ability to bundle products dynamically prevents airlines from creating differentiated value propositions that

combine flight services with ancillary products such as baggage allowances, seat selections, lounge access, and ground transportation in ways that maximize both customer satisfaction and revenue capture across the entire journey experience. Furthermore, the minimal capacity for personalization means that airlines cannot effectively leverage customer data, purchase history, loyalty tier status, or behavioral patterns to create tailored offers that reflect individual preferences and maximize conversion rates [4]. The architecture essentially forces airlines to design products around system capabilities and technical constraints rather than market opportunities or customer preferences, inverting the natural relationship between technology enablement and business strategy execution. Additionally, the complexity of servicing operations—particularly reissues, exchanges, and refunds—requires intricate manipulation of multiple document components including ticket coupons, fare calculation records, tax breakdowns, and ancillary service documentation, often demanding manual intervention by specialized personnel with deep knowledge of arcane business rules, fare construction principles, and system-specific command structures that have accumulated over decades of incremental system modifications.

## 3. The Conceptual Foundation of Modern Retail Architecture

The emerging paradigm introduces two fundamental constructs that redefine airline commerce and represent a wholesale departure from document-centric legacy systems that have constrained industry innovation for decades. The first element represents a dynamic commercial proposition generated in real-time based on specific customer context and travel requirements, enabling airlines to move beyond the constraints of predefined fare structures and static product catalogs that limit competitive differentiation. Rather than presenting static product inventories constrained by rigid booking class hierarchies and filed fare rules, this approach enables airlines to construct tailored propositions that integrate flight products, ancillary services, contextual pricing, and relevant bundling strategies in ways that reflect actual customer needs and willingness-to-pay at the moment of shopping. The generation process evaluates multiple variables including customer profile attributes such as loyalty status and travel patterns, purchase history spanning previous transactions and channel preferences, current availability across the network, competitive dynamics in the relevant markets, and sophisticated optimization algorithms that balance revenue objectives with conversion probability to produce differentiated retail outputs that maximize both customer value perception and airline revenue capture. Research examining the evolution of airline distribution and retailing capabilities demonstrates that traditional distribution channels have fundamentally limited airlines' ability to implement sophisticated merchandising strategies, with legacy systems constraining product presentation, pricing flexibility, and the ability to differentiate offerings based on customer characteristics or purchase context [5]. The technical architecture supporting dynamic proposition generation requires integration of multiple data sources including customer relationship management systems, inventory databases, pricing engines, and real-time decisioning platforms that can process complex algorithms within milliseconds to deliver personalized propositions during the shopping experience, representing a significant technological advancement over batch-processed fare filing systems [5].The second element consolidates all commercial information into a single comprehensive record that serves as the authoritative source throughout the customer journey, eliminating the fragmentation that has characterized airline distribution since the introduction of computerized reservation systems. This unified structure captures all purchased products including flight segments and ancillary services, detailed pricing and tax calculations broken down by component and jurisdiction, payment instruments and transaction authorization details, fulfillment status tracking across all service elements, and complete servicing history documenting every modification, exchange, or refund throughout the booking lifecycle. By eliminating document fragmentation that previously distributed customer information across reservation records, ticketing instruments, ancillary service documentation, and financial settlement artifacts, this approach fundamentally simplifies the commercial relationship and creates a coherent foundation for all subsequent interactions whether initiated by the customer, airline personnel, or automated service recovery systems. Analysis of airline retailing evolution indicates that consolidating transaction information into unified records enables airlines to better manage the complete customer relationship and respond more effectively to servicing requests, disruptions, and modification scenarios that previously required complex cross-system reconciliation processes [6]. The unified record structure supports real-time visibility into the complete commercial

relationship, enabling both customers and airline personnel to understand the full scope of purchased services, current fulfillment status, and available modification options without navigating multiple systems or reconciling potentially inconsistent data across disparate documents that may update asynchronously [6].

## 4. Operational and Commercial Advantages

Unified commercial records transform servicing operations by decoupling fulfillment from complex document structures that have historically required specialized knowledge and manual intervention to manage effectively across fragmented legacy systems that were never designed to support integrated customer relationship management. Modifications, exchanges, and refunds become straightforward record updates rather than multi-document reconciliation exercises that involve manipulating ticket coupons, recalculating fare differentials, adjusting tax components, and coordinating changes across multiple systems with different data models and update protocols that were designed independently over decades of technological evolution without consideration for end-to-end customer experience optimization. This simplification particularly benefits ancillary service management, where previously each component required separate documentation and processing through distinct workflows, creating operational friction and increasing the likelihood of errors during modification scenarios that involve changing seat assignments, baggage allowances, meal preferences, or other supplementary services that passengers may need to adjust as their travel plans evolve. Disruption management similarly benefits from consolidated information that enables rapid assessment and resolution when operational irregularities occur, allowing airline personnel to quickly understand the complete scope of affected services and implement appropriate recovery actions without navigating multiple systems to gather necessary customer and booking information during time-sensitive irregular operations scenarios. Research examining transportation systems and their operational characteristics indicates that the efficiency of service delivery and modification processes significantly impacts overall system performance and customer satisfaction, with integrated information architectures enabling more responsive and effective operations management compared to fragmented legacy approaches [7]. The consolidation of commercial information into unified records reduces the technical complexity of servicing operations while simultaneously improving data accuracy and reducing the time required to process customer requests, whether initiated through self-service channels or assisted by airline contact center personnel who must access complete booking information to resolve customer inquiries effectively [7].The retail capabilities enabled by dynamic proposition generation represent a substantial advancement in airline commercial sophistication and competitive positioning within the broader travel marketplace where consumer expectations have been shaped by digital retailers offering personalized, contextualized shopping experiences across various industries. Airlines gain the ability to implement continuous pricing strategies that align charges with real-time demand signals and individual willingness-to-pay rather than rigid fare buckets defined weeks or months in advance through traditional fare filing processes that cannot respond dynamically to changing market conditions or competitive actions. Personalization becomes feasible at scale, allowing differentiation based on customer segments, loyalty tier status, historical purchase patterns, and behavioral characteristics that indicate preferences and price sensitivity across different journey types and booking contexts. Dynamic bundling enables sophisticated product construction that responds to specific customer needs and trip contexts, maximizing perceived value by combining flight products with ancillary services in configurations that resonate with particular customer segments. Research analyzing airline distribution and revenue strategies demonstrates that modern retailing capabilities enable carriers to optimize their commercial performance through enhanced merchandising, dynamic pricing, and personalized offer construction that increases both conversion rates and average transaction values across diverse customer segments [8]. This retail sophistication extends across all distribution channels, ensuring consistency whether customers engage directly through airline websites and mobile applications, through intermediaries, or via corporate booking tools, thereby eliminating fare disparity issues while maintaining brand control and merchandising effectiveness [8].

## 5. Strategic Implications for Revenue Optimization

This transformation literally turns revenue management inside out, reorienting the discipline from a capacity optimization approach to a value optimization approach focused on the customer. The commercial decision-making model for airlines shifts from the static inventory control of a portfolio of fare classes with business rules across

different booking horizons based on historical booking profiles and forecasted load factors to dynamic optimization of differentiated commercial offers in response to constantly changing demand signals, market price and product space, competitor response and possible customer-specific demand variation. By using the freedom and flexibility available with product configuration, pricing and bundles, airlines can learn and adapt their commercial strategy, and test and validate the hypotheses about customer preferences, price elasticity, optimal product bundles by market segment/booking profile and the impact of these factors on conversion and total revenue per customer. This results in better pricing and product decisions by customer context, allowing airlines to capture more value and improve perceived customer benefit through propositions that are more closely aligned with customer needs, preferences and willingness to pay for each segment, instead of forcing customers to fit into commodity fare classes, with the same bundles for all customers regardless of their profile and value perception. Similar to research that has been conducted comparing the business models of airlines, it is shown that highly revenue management focused airlines perform their best when their offer aligns to the customer buying process, and their operational performance varies greatly when airlines utilize their commercial and distribution capabilities to the max [9]. The multi-dimensional optimization framework allows airlines to evaluate more complex decisions that manage the trade-off between short term revenues and the long term need to build customer relationships and market share, by putting weight on the sometimes conflicting objectives of maximizing single transaction values and optimizing customer loyalty and lifetime value [9].The accompanying change within the commercial roles is a shift away from an inventory management function - including allocation and fare class management - to a retail management function - including customer segmentation, behavioral economics, personalization and omnichannel. A key enabler of this shift is for optimization and customer analytics to become core competencies of commercial teams, not just specialized capabilities of revenue management departments. Such a reorganization requires investment in staff training, analytical infrastructure and decision systems that can manage and mine the customer, market, and operations data generated by new pricing and product strategies, across multiple, complex distribution channels. In a study of airline ancillary service strategies it was found that in general, airlines are using ancillary products and services to diversify their revenue streams, with many airlines seeing ancillary revenue as a key component of profitability in the face of competitive fare pressure and commoditization of air fares. Machine learning algorithms, predictive analytics and real-time optimization engines allow an airline to continuously learn from and respond to passenger behavior, competitors' behavior and the market, improving commercial performance through a feedback loop of iterating pricing strategies, bundles, and merchandising tactics. This analytical sophistication is a meaningful departure from the rule-based batch processing approach to revenue management that has characterized airline commercial operations for decades, requiring both technology renewal and cultural change within commercial organizations.

***Table 1:*** *Commercial Capability Gap Between Legacy and Modern Airline Distribution Systems [3, 4]*

| Commercial Capability | Legacy System Capability (%) | Modern System Potential (%) | Constraint Severity | Revenue Impact |
|---|---|---|---|---|
| Dynamic Pricing Granularity | 25 | 95 | Critical | High |
| Real-Time Price Adjustments | 15 | 90 | Severe | Very High |
| Customer Personalization | 20 | 85 | Critical | High |
| Dynamic Product Bundling | 30 | 90 | Severe | Very High |
| Ancillary Service Integration | 40 | 95 | Moderate | High |
| Context-Based Offers | 10 | 85 | Critical | Very High |
| Cross-Channel Consistency | 50 | 95 | Moderate | Medium |
| Merchandising Flexibility | 35 | 90 | Severe | High |

***Table 2:*** *Commercial Capability Evolution from Legacy to Modern Retail Architecture [5, 6]*

| Commercial Capability | Legacy System Support | Modern Architecture Support | Customer Value Impact | Revenue Capture Potential | Implementation Complexity |
|---|---|---|---|---|---|
| Real-Time Personalization | Limited | Comprehensive | High | Very High | High |
| Dynamic Pricing | Minimal | Full | Very High | Very High | Very High |
| Contextual Bundling | None | Advanced | High | High | Medium |
| Loyalty Integration | Basic | Deep | Medium | High | Medium |
| Channel Consistency | Partial | Complete | High | Medium | High |
| Cross-Sell Optimization | Limited | Sophisticated | High | Very High | High |
| Customer Journey Tracking | Fragmented | Unified | Very High | High | Medium |
| Servicing Automation | Minimal | Extensive | Very High | Medium | High |

***Table 3:*** *Distribution Channel Consistency Enhancement Through Unified Retail Architecture [8, 9]*

| Distribution Channel | Legacy System Consistency (%) | Unified System Consistency (%) | Fare Disparity Issues (Legacy) | Fare Disparity Issues (Unified) | Merchandising Control |
|---|---|---|---|---|---|
| Airline Direct Website | 85 | 98 | Medium | Minimal | Full vs. Full |
| Mobile Application | 80 | 98 | Medium | Minimal | High vs. Full |
| Travel Agency Channels | 65 | 95 | High | Low | Limited vs. High |
| Online Travel Platforms | 60 | 95 | Very High | Low | Limited vs. High |
| Corporate Booking Tools | 70 | 96 | High | Low | Medium vs. High |
| Call Center | 75 | 97 | Medium | Minimal | Medium vs. High |
| Airport Counter | 80 | 98 | Low | Minimal | High vs. Full |
| Third-Party Aggregators | 55 | 94 | Very High | Low | Minimal vs. Medium |

***Table 4:*** *Strategic Balance Evolution in Multi-Dimensional Revenue Optimization [9, 10]*

| Optimization Dimension | Traditional Focus (%) | Modern Balance (%) | Decision Complexity | Time Horizon | Value Creation Potential | Risk Level |
|---|---|---|---|---|---|---|
| Immediate Transaction Revenue | 90 | 40 | Low | Instant | Medium | Low |
| Conversion Rate Optimization | 5 | 20 | Medium | Short-Term | High | Low |
| Customer Lifetime Value | 2 | 20 | High | Long-Term | Very High | Medium |
| Market Share Development | 2 | 10 | High | Medium-Term | High | Medium |
| Brand Loyalty Building | 1 | 10 | High | Long-Term | Very High | Low |

## 6. Conclusions

The move from document-based distribution architectures, to offer-and-order retail, is among the most important and far-reaching transformations in

airline commercial history, changing the way carriers create, distribute and fulfill their offer in a fast-evolving digital, omnichannel environment. The previous technologies involved disaggregated PNR, e-tickets, and separate ancillary documentation, which have made airline commercial agility difficult for decades, causing airlines to create products based on technical capabilities instead of customer demand. The new model solves these issues using relevant customer context to create dynamic propositions, creating fully consolidated commercial records that remove document fragmentation, and streamlining servicing processes and revenue management. This enables airlines to compete with digital retailers by creating continuous pricing, customer-centric bundles, omnichannel consistency and data-led commercial experimentation. This requires broad and deep change not only from infrastructure to people, analytics and culture as commercial organizations move from inventory managers to retail strategists, but also cross-industry collaboration and supporting interoperability during extended hybrid transition periods. Finally, creating a new marketplace for airline retailing also requires a top-to-bottom rethink of the accounting and settlement processes that have become secured within legacy airline infrastructure. Irrespective of potential complexity, the opportunity offered by adoption is meaningful across four main dimensions: revenue potential (through personalization and dynamic offers), efficiency (reduced servicing complexity and error-prone activity), customer experience (aligning with market and digital commerce best practices), and commercial agility (the ability to respond to competitive and market pressures). In continuing toward this journey, airlines that master the trade-off between new retailing capabilities and operational complexity will inevitably position themselves best to capitalize on disproportionate value in a changing competitive landscape where differentiating capabilities are based on the sophistication of the retail proposition driving the customer experience.

## Author Statements:

- **Ethical approval:** The conducted research is not related to either human or animal use.
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