People's Democratic Republic of Algeria
Ministry of Higher Education and Research Scientist

UNIVERSITY ECHAHID HAMMA LAKHDAR - EL OUED
FACULTY OF ECONOMICS, BUSINESS, MANAGEMENT AND ECONOMICS

ECONOMICS DEPARTEMENT

Dissertation for the Master Degree
Project to obtain an economic establishment certificate pursuant to Ministerial Resolution No. 1275
Ttitle:Amalate (Amadeus Simulation)

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Academic degree applied for:	**Master**
Field:	**Faculty of Economics, Business, Management and Economics**
Domain:	**Faculty of Economics**
Specialty:	**Quantitative Economics**
Date of Discussion:	**July 9, 2025**

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University season: 20**24**-20**25**

Acknowledgment

Praise be to God, by whose grace good deeds are accomplished, and by whose favor we reach the fruits of effort and joy after the journey.

My heart overflows with gratitude as I write these words, after a path filled with challenges, learning, and shared dedication.
First, I would like to express my deepest thanks and appreciation to my esteemed supervisor, DR. EL HADJ AHMED FAOUZI, whose guidance and support were a constant light throughout the preparation of this thesis. Thank you for your wisdom, patience, and belief in me.

To my dear husband, my partner in life and in this achievement…
You were not just a distant supporter — you were with me hand in hand, thought by thought, and a steady shoulder when I felt weak. A true partner in every step of this work.
Thank you for believing in this project as much as I did, for enduring with me, working beside me, and staying up through long nights. This success is yours as much as it is mine, and this moment would not have come without you.

I also extend my heartfelt thanks to everyone who supported me throughout this journey — respected professors, my beloved family, and dear friends, whose words, prayers, and encouragement were a heartbeat that pushed me forward.

To you all… my deepest and most sincere gratitude.

Dedication

To those who were the light when darkness fell, the support when the burden was heavy, and the warmth when the cold of life crept in...

To my dear mother - the inexhaustible source of tenderness and prayer,

To my beloved father - who taught me to persevere and build dreams step by step,

To my dear brothers - the pillars of my strength, always present when life faded,

To my little sister - the flower of our home and the joy of my heart,

To my beloved husband - my soul mate, the mirror of my strength, and my true support in every moment of weakness... Thank you for believing in me before I arrived.

To my kind aunt - a constant warm embrace, a comforting word, and a sincere prayer,

To my dear grandmother - a woman who loved knowledge and instilled in me a deep passion for learning,

To my beloved grandfather - the smiling heart, the love of my soul, the calm in my storms, and the compassion in my adversity... Your presence will live on in my heart forever.

To all of you, I dedicate this work - the harvest of years of effort, a

dream that began with you, and was realized thanks to you.

Abstract

This project focuses on the design and development of a simulation program that replicates the core functionalities of the Amadeus Airline Reservation System (ARS), with the aim of creating an educational and training tool for students, researchers, and professionals interested in understanding the complexities of airline booking systems. The simulation covers essential processes such as flight search, seat availability, booking confirmation, and ticket issuance within an interactive and realistic environment.

The current version of the project has been developed as a desktop application, using technologies such as Python and SQL, and follows a modular architecture that allows for future expansion and improvements. Key technical challenges such as handling concurrent booking requests, ensuring data integrity, and optimizing system response time were addressed using efficient algorithms and robust database management techniques.

This project represents the first phase of a larger initiative, with plans to transform the application into a web-based platform in the future to ensure broader accessibility and scalability. As such, this simulation contributes to the advancement of technical education in the aviation sector by offering a flexible and practical model of a globally recognized airline reservation system.

Résumé

Ce projet porte sur la conception et le développement d'un programme de simulation reproduisant les principales fonctionnalités du système de réservation de billets d'avion Amadeus (Amadeus Airline Reservation System – ARS), dans le but de créer un outil pédagogique et de formation destiné aux étudiants, chercheurs et professionnels souhaitant comprendre les complexités des systèmes de réservation aérienne. La simulation couvre les processus essentiels tels que la recherche de vols, la vérification de la disponibilité des sièges, la confirmation des réservations et l'émission des billets, le tout dans un environnement interactif et réaliste.

La version actuelle du projet a été développée sous forme d'application de bureau (desktop), en utilisant des technologies telles que Python et SQL, et repose sur une architecture modulaire permettant des extensions et améliorations futures. Les principaux défis techniques – notamment la gestion des demandes de réservation simultanées, l'intégrité des données, et l'optimisation du temps de réponse – ont été relevés à l'aide d'algorithmes efficaces et d'une gestion robuste de base de données.

Ce travail représente la première phase d'une initiative plus vaste, avec pour objectif de transformer cette application en une plateforme web à l'avenir, afin de garantir une accessibilité plus large et une meilleure évolutivité. Ainsi, cette simulation contribue au renforcement de la formation technique dans le domaine de l'aérien en proposant un modèle flexible et pratique d'un système de réservation mondialement reconnu.

ملخص

يركز هذا المشروع على تصميم وتطوير برنامج محاكاة يُعيد إنتاج الوظائف الرئيسية لنظام حجز تذاكر الطيران أماديوس

(Amadeus Airline Reservation System - ARS) ، وذلك بهدف إنشاء أداة تعليمية وتدريبية موجهة للطلاب والباحثين والمهنيين الراغبين في فهم تعقيدات أنظمة الحجز الجوي. تغطي المحاكاة العمليات الأساسية مثل البحث عن الرحلات، التحقق من توفر المقاعد، تأكيد الحجوزات، وإصدار التذاكر، وذلك ضمن بيئة تفاعلية وواقعية.

تم تطوير النسخة الحالية من المشروع على شكل تطبيق مكتبي باستخدام تقنيات مثل Python وSQL، ويعتمد على بنية معمارية معيارية تسمح بالتوسعة والتحسينات المستقبلية. وقد تم التغلب على التحديات التقنية الرئيسية، بما في ذلك إدارة طلبات الحجز المتزامنة، وضمان سلامة البيانات، وتحسين سرعة الاستجابة، من خلال استخدام خوارزميات فعالة ونظام إدارة قواعد بيانات قوي.

يمثل هذا العمل المرحلة الأولى من مبادرة أوسع تهدف مستقبلاً إلى تحويل هذا التطبيق إلى منصة ويب، لضمان وصول أوسع وقابلية أكبر للتطوير. وبذلك، تُسهم هذه المحاكاة في تعزيز التكوين التقني في مجال الطيران من خلال تقديم نموذج مرن وعملي لنظام حجز معترف به عالمياً.

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General Introduction

General Introduction

In today's digital age, the travel and tourism industry has undergone a profound transformation, driven by the emergence of sophisticated technological platforms. One of the most prominent and widely used systems in this domain is the Amadeus Booking Platform, a leading Global Distribution System (GDS) that facilitates real-time access to flight, hotel, car rental, and other travel-related services. This platform serves as a critical backbone for travel agencies, airlines, and other travel providers, offering seamless integration and connectivity across the global travel ecosystem.

The growing demand for travel services—combined with customers' expectations for speed, accuracy, and personalized options—has pushed technology providers to offer robust, secure, and scalable solutions. Amadeus, through its advanced API services and intuitive interfaces, has become a dominant player in this field. However, the complexity of the system and its underlying architecture requires a deep understanding of both its operational logic and technical structure.

This thesis is focused on the simulation and partial implementation of the Amadeus booking process, with the objective of understanding how such systems are designed, modeled, and integrated. By building a prototype and exploring the workflows behind bookings—such as flight search, PNR creation, fare calculation, and ticketing—this work aims to bridge the gap between theoretical knowledge and real-world application.

Objectives

The main objectives of this project are:

- To analyze the structure and features of the Amadeus booking platform.
- To simulate core functionalities such as flight search, reservation, and ticketing using available APIs.
- To design and develop a simplified version of a booking interface that demonstrates the principles of GDS operation.
- To evaluate the simulation in terms of usability, reliability, and performance.

Research Questions

RQ1: To what extent can a simulated environment that replicates the Amadeus booking system improve understanding of Global Distribution Systems (GDS) among students and developers?

RQ2: Is it technically feasible to design and implement a simplified flight booking simulation using mock or open APIs while maintaining the core functionalities of a real GDS platform?

RQ3: How do users perceive the educational and practical value of the simulated system in terms of usability, realism, and relevance to the travel industry?

RQ4: What are the major technical challenges involved in simulating GDS booking functions (e.g., PNR creation, fare calculation, synchronization), and how can these challenges be mitigated through architectural and design choices?

Research Hypotheses

- **H1:** A simulated environment that reproduces key booking functions of the Amadeus system can effectively support learning and understanding of GDS technologies.
- **H2:** It is possible to design and implement a simplified version of a flight booking platform that demonstrates core operations such as flight search, reservation, and ticketing using open or mock APIs.
- **H3:** Users (students and developers) will find the simulation beneficial for acquiring practical knowledge of GDS operations and software design principles in the travel industry.
- **H4:** Technical challenges related to the integration and simulation of booking functions (e.g., data synchronization, PNR logic, fare calculation) can be mitigated through modular architecture and abstraction of core processes.

Significance of the Study

This project provides educational value by offering a model that demystifies how real booking engines operate. It also presents a technical foundation that can be extended to more complex systems or even integrated into educational platforms. For academic purposes, it supports learning in software engineering, distributed systems, and web-based application development.

Structure of the Memoir

This thesis is structured into five chapters:

- **Chapter 1** Theoretical Foundation of the Amadeus System
- **Chapter 2** Core Architecture and Functional Simulation.
- **Chapter 3** Application Development and Database Implementation.
- **Chapter 4** User Guide: Booking a Flight through the AMALATE.

Chapter 01:

Theoretical Foundation of the Amadeus System

Chapter 1

Theoretical Foundation of the Amadeus System

1.1 Introduction

Travel and tourism represent one of the largest global industries, generating billions in revenue annually. Central to the industry's operation are travel booking systems that enable consumers, travel agents, and service providers to reserve flights, hotels, car rentals, and other travel-related services. The shift from manual, paper-based reservations to computerized systems revolutionized how the travel sector operates.

This chapter presents an extensive theoretical overview of travel and airline booking systems, with an emphasis on the Amadeus platform, a leading Global Distribution System (GDS). The chapter outlines the historical context, system architecture, booking workflows, and comparative positioning against competitors, setting the foundation for the technical and simulation aspects discussed in later chapters.

1.2 Evolution of Travel and Airline Booking Systems

- **Pre-1960s Manual Era:**
  Travel bookings were conducted primarily through travel agents communicating via telephone, telegraph, or physical documents. This process was highly inefficient, prone to errors, and limited by human availability.1
- **Introduction of Computerized Reservation Systems (CRS):**
  American Airlines launched Sabre in 1960, one of the first CRS systems. CRSs digitized inventory and bookings for a single airline, allowing faster reservation processing and centralized data management.2
- **Emergence of Global Distribution Systems (GDS):**
  By the 1980s, multiple CRSs evolved into GDS platforms integrating multiple airlines and travel service providers into unified systems accessible by travel agents worldwide. Amadeus was created by European airlines in 1987 as a major GDS to compete globally.3

1 Copeland, D. G., & McKenney, J. L. (1988). Airline reservation systems: Lessons from history. MIS Quarterly, 12(3), p353–370.

2 Buhalis, D. (2003). eTourism: Information Technology for Strategic Tourism Management. Pearson Education.

3 Law, R., Leung, R., & Buhalis, D. (2009). Progress in information technology and tourism management: 20 years on and 10 years after the Internet. Tourism Management, 29(4), p609–623.

- **Internet and Mobile Disruption:**
  Since the late 1990s, online travel agencies (OTAs) and airline websites gave consumers direct access to booking platforms. Mobile apps and APIs today allow real-time, self-service bookings globally, bypassing traditional travel agencies.4
- **Future Trends:**
  Emerging technologies such as Artificial Intelligence (AI), blockchain, and distributed ledger technologies are poised to further revolutionize travel bookings with enhanced personalization, fraud prevention, and decentralized data management.5

1.3 Traditional vs. Modern Booking Systems (Comparative Table)6

Feature	Traditional Systems	Modern Booking Systems
User Access	Travel agents only	Agents, customers, third-party platforms
Data Processing Speed	Slow, batch processing	Real-time, instant processing
Interface	Command line or dedicated terminals	Graphical User Interfaces, mobile-friendly
Integration Level	Single airline or service	Multi-provider, multi-service
Flexibility	Rigid fare rules, manual overrides	Dynamic pricing, automated fare calculation
Payment & Ticketing	Paper tickets, manual accounting	Electronic tickets, integrated payment systems
Data Analytics	Limited	Big data, predictive analytics

Table (1, 1): Traditional vs. Modern Booking Systems

1.4 Introduction to Amadeus7

1.4.1 History and Development

The Amadeus IT Group S.A**.**, headquartered in Madrid, Spain, was officially created in 1987 through a strategic alliance of four major European airlines: Air France, Iberia, Lufthansa, and Scandinavian Airlines System (SAS). This joint venture aimed to build a Europe-based Global

4 Amadeus IT Group. (2021). Technology and innovation in travel: Trends shaping the future. Retrieved from https://amadeus.com

5 Sheldon, P. J. (1997). Tourism Information Technology. CAB International.

6 Buhalis, D., & Law, R. (2008). Progress in information technology and tourism management: 20 years on and 10 years after the Internet. Tourism Management, 29(4), p609–623.

7 Amadeus IT Group. (2021). Amadeus Company History and Milestones. Retrieved from https://amadeus.com

Distribution System (GDS) that could compete with the growing dominance of American systems such as Sabre (American Airlines) and Apollo/Galileo (United Airlines).

Amadeus was formally registered as a company in Madrid but established its central operations in Nice, France, where the core software development and technical infrastructure were based. Over time, its data processing center (Amadeus Data Processing) was built in Erding, Germany, which remains one of the most advanced travel technology hubs in the world.

1.4.2 Strategic Objectives in Founding:

- Enable European airlines to have greater control over global reservations.
- Create a unified platform to serve the growing needs of travel agencies.
- Modernize the travel booking process through a centralized, computerized system.

1.4.3 Key Historical Milestones:8

Year	Milestone
1987	Company founded by Air France, Iberia, Lufthansa, and SAS.
1992	Amadeus becomes fully operational, offering airline booking and reservations.
1995	Expansion into hotel and car rental content; first U.S. office established.
1999	Launch of **e-Travel**, Amadeus's online travel booking solution.
2000	Listed on the Madrid Stock Exchange.
2004–2005	Entry into **airline IT services** with the **Amadeus Altéa Suite**.
2010	Re-listed on stock exchange after privatization by BC Partners and Cinven.
2012	Launch of Amadeus Airline Ancillary Services (for selling extra baggage, meals, etc.).
2015–2018	Heavy investment in **Big Data**, **AI**, and **cloud computing**.
2020–2024	Strategic partnership with **Microsoft Azure** to modernize infrastructure.

Table (1, 2): Key Historical Milestones

1.4.4 Technology Evolution:9

- From mainframe-based computing in the early 90s to modular, cloud-native architecture.
- Adoption of Open Systems, SOAP/XML APIs, and later RESTful web services for NDC.
- Introduction of machine learning to optimize search results and dynamic pricing.

8 Amadeus IT Group. (2023). Company milestones and innovation timeline. Retrieved from https://amadeus.com/en/about/our-company/our-history

9 Amadeus IT Group. (2022). Technology for smarter travel: API solutions and digital innovation. Retrieved from https://amadeus.com

1.5 Position in the Airline Industry10

Amadeus is not just a GDS provider it is a global travel technology powerhouse that plays a dual role in the travel ecosystem:

1. **As a Global Distribution System (GDS)**:
    - Aggregates and distributes content (flights, hotels, cars) to travel agencies, online travel agencies (OTAs), and corporations.
    - Offers real-time search and booking capabilities via its API and graphical interfaces (e.g., Amadeus Selling Platform Connect).
2. **As a Provider of Airline IT Solutions**:
    - Supplies mission-critical systems such as Passenger Service Systems (PSS), Departure Control Systems (DCS), Revenue Accounting, and Loyalty Programs.

Key Market Position Highlights:

- Over 600 million bookings annually, covering flights, trains, hotels, cruises, and cars.
- Serving more than 440 airlines across the globe, including full-service and low-cost carriers.
- Used by over 100,000 travel agencies, corporate travel departments, and online travel portals.
- Provides IT systems to over 220 airlines for their operational infrastructure.
- Presence in 190+ countries, making it a true global provider.

Global Clients Include:

- **Airlines**: Lufthansa, Qatar Airways, British Airways, Emirates (partial), Singapore Airlines.
- **Hotels**: Marriott, Accor, IHG, Hilton (via integrations).
- **Rail & Ground**: SNCF (France), Deutsche Bahn (Germany), and others.

Strategic Advantages:

- **Altéa Suite**: A fully integrated IT suite for airline reservations, inventory, and departure control. It ensures real-time synchronization between systems, enhancing customer service.
- **New Distribution Capability (NDC)**: Amadeus has been an early adopter and developer of NDC-compliant systems, allowing for richer content (e.g., fare bundles, seat maps, baggage options).
- **Data Analytics**: Offers advanced data intelligence solutions for travel patterns, pricing optimization, and market forecasting.

Global Market Share (Approx.):

10 Amadeus IT Group. (2023). A trusted technology partner to the travel industry. Retrieved from https://amadeus.com/en/industries/airlines

- **40%** of airline bookings in Europe go through Amadeus.
- **25–30%** global market share in GDS-based air bookings (varies by region).
- A leading player in airport solutions, now installed in over 125 airports worldwide.

1.6 Role in the Modern Travel Ecosystem11

Amadeus is now more than just a reservation system; it acts as a connective hub for the modern digital travel environment. It enables:

- Dynamic pricing based on passenger demand and competitive analysis.
- Personalized retailing by integrating AI-driven user behavior prediction.
- Seamless connectivity with mobile apps, self-service kiosks, and third-party platforms.
- Sustainability support, helping airlines and agencies monitor and report carbon emissions.

Amadeus's ability to evolve with the travel industry, particularly through cloud innovation, API integrations, and digital retailing, ensures that it remains a crucial enabler in a rapidly changing global travel market.

1.7 Architecture and Services12

- **Modular, Scalable Design:**
  Amadeus uses a multi-tier architecture consisting of:
  - **Presentation Layer:** Interfaces for users (agents, customers, partners) through terminals, web portals, and APIs.
  - **Business Logic Layer:** Rules engines for fare calculation, availability checks, itinerary pricing, and ticketing.
  - **Data Layer:** Centralized databases storing fare tariffs, schedules, PNR data, and customer profiles.
- **Cloud Infrastructure:** Transitioning to cloud-based platforms for enhanced scalability, resilience, and geographic distribution.
- **Core Services:**
  - **Airline Reservation:** Comprehensive flight search, availability, booking, cancellations, and ticketing.
  - **Hotel Booking:** Real-time access to hotel inventories with dynamic pricing and booking confirmation.
  - **Car Rentals:** Integration with major rental companies for inventory, pricing, and bookings.
  - **Rail and Cruise:** Regional offerings for train and cruise reservations.

11 Amadeus IT Group. (2023). The future of travel: Personalization, sustainability, and smart connectivity. Retrieved from https://amadeus.com

12 Amadeus for Developers. (2023). Amadeus API documentation and architecture overview. Retrieved from https://developers.amadeus.com

- **Ancillary Services:** Special services like seat selection, baggage management, and travel insurance.

1.8 API and GDS Functionality13

- **API Types:**
  - **SOAP APIs:** Traditional, widely used in enterprise systems, supporting structured XML messaging.
  - **RESTful APIs:** Lightweight, JSON-based, and suitable for web and mobile applications.
- **API Capabilities:**
  - Search and retrieve schedules and availability.
  - Display fare rules and pricing options dynamically.
  - Create, modify, or cancel bookings and PNRs.
  - Issue electronic tickets and process refunds.
- **Developer Ecosystem:** Amadeus provides extensive SDKs, documentation, sandbox environments, and support forums to foster third-party integration and innovation.

1.9 GDS Functionality Overview14

A Global Distribution System (GDS) is a centralized electronic platform that enables the real-time distribution and reservation of travel services across the globe. Originally developed to help airlines manage bookings through travel agents, GDS platforms have evolved into comprehensive travel marketplaces, connecting multiple service providers (airlines, hotels, car rental companies, cruise lines) with sellers (travel agencies, OTAs, corporate travel systems).

GDS functionality refers to the core set of features these systems provide to enable seamless search, pricing, booking, ticketing, and servicing of travel itineraries. It integrates with back-end systems like inventory management, fare engines, and payment processing systems.

1.9.1 Content Aggregation

GDSs aggregate content from various providers and present it in a unified interface:

- **Flights**: Domestic, international, full-service, low-cost.
- **Hotels**: Chain and independent properties.
- **Cars**: Major and regional rental providers.
- Trains, ferries, cruises, and even insurance and activities.

13 Amadeus for Developers. (2023). Build travel applications with Amadeus APIs. Retrieved from https://developers.amadeus.com

14 Sheldon, P. J. (1997). Tourism Information Technology. Wallingford, UK: CABI Publishing. pp. 59–78.

This aggregation allows agents and systems to compare and book services across providers using a single platform.

1.9.2 Real-Time Availability and Dynamic Pricing

- GDSs provide instant access to real-time availability for seats, rooms, and cars.
- They use dynamic pricing algorithms, updating fare and rate data as supply and demand fluctuate.
- Airlines push fare classes, yield-managed prices, and ancillary offers via the GDS in real-time.

1.9.3 Multi-Airline and Interline Booking

- Users can build multi-leg itineraries with different airlines (e.g., Lufthansa + Qatar Airways) on a single ticket.
- The GDS automatically handles fare combinability rules, interline agreements, and baggage transfers.
- Supports codeshare flights, allowing passengers to book flights operated by partner carriers.

1.9.4 Fare Construction and Pricing Rules

- GDSs incorporate comprehensive fare calculation logic:
    - Public fares, private fares, negotiated fares.
    - Fare basis codes, tax rules, and ticketing deadlines.
    - Branded fares and fare families (economy light, basic, flex, etc.).
- Use of ATPCO (Airline Tariff Publishing Company) and IATA fare rules.

1.9.5 Passenger Name Record (PNR) Management

- Each booking creates a Passenger Name Record (PNR) that stores:
    - Passenger data (name, contact info).
    - Travel itinerary (flights, hotels, cars).
    - Fare details and ticket number.
    - Special requests (meal, wheelchair, frequent flyer info).
- Agents can modify or cancel PNRs, reissue tickets, and track changes.

1.9.6 E-Ticketing and Settlement

- Enables automated issuance of electronic tickets (e-tickets).
- Integrates with BSP (Billing and Settlement Plan) or ARC (Airlines Reporting Corporation) for payment and reconciliation.
- Supports:
    - Partial or full refunds.
    - Ticket exchanges and reissues.
    - Penalty fees and fare recalculations.

1.9.7 Ancillary Services and Merchandising

- Supports Airline Retailing:
  - Seat selection (including paid premium seats).
  - Extra baggage.
  - Priority boarding.
  - Lounge access, meals, Wi-Fi.
- Airlines can upsell branded offers using Amadeus's NDC-compliant merchandising engine.

1.9.8 Corporate and Leisure Booking Tools

- Corporate travel systems (like Amadeus Cytric) integrate GDS for policy-based bookings.
- Leisure-focused tools allow dynamic packaging: flights + hotel + car + insurance.

1.9.9 API Integration and Custom Interfaces

- GDSs provide APIs (SOAP, REST) to connect with:
  - Online Travel Agencies (OTAs) like Expedia, Booking.com.
  - Meta-search engines (Google Flights, Skyscanner).
  - Custom corporate booking tools.
- This allows automation, personalization, and integration with CRMs, ERPs, and mobile apps.

1.9.10 Back-Office and Reporting Functions

- Real-time booking logs, audit trails, and revenue tracking.
- Generates:
  - Invoices
  - Agent productivity reports
  - Commission statements
  - Travel management analytics for corporations

1.10 Stakeholders and System Integration[15]

Amadeus functions as a centralized technology platform in the global travel ecosystem, connecting multiple stakeholders across the airline, hospitality, and transportation sectors. It facilitates seamless communication, booking, and service delivery between these parties by integrating global distribution standards and modern APIs.

15 Amadeus IT Group. (2023). Powering the travel ecosystem: Solutions for airlines, travel agencies, and online platforms. Retrieved from https://amadeus.com

User Type	Use Case
Travel Agencies	Booking multi-provider travel services for clients.
Online Travel Agencies (OTAs)	Integration via API to power websites/apps.
Corporate Travel Managers	Book and control employee travel via GDS-integrated systems.
Airlines	Distribute inventory, manage fares, and reach global customers.
Hotels & Cars	List rooms and vehicles, manage rates and availability.
Rail & Cruise Lines	Expand reach to agents and international customers.

Table (1, 3): Stakeholders and System Integration

1.10.1 Key Stakeholders in the Amadeus Ecosystem

Airlines

Airlines use Amadeus as both a Global Distribution System (GDS) and an IT services provider to distribute their products (flights, ancillaries, fare bundles) to a global market.

- **Key Functions for Airlines:16**

  - Real-time inventory and pricing distribution to travel agents and OTAs.
  - Access to Amadeus Altéa Suite (for reservations, inventory, and departure control).
  - Implementation of dynamic pricing, fare families, and branded fares.
  - Integration with Amadeus Revenue Management and Loyalty platforms.

Example: Lufthansa uses Amadeus to manage bookings, seat maps, ancillaries, and frequent flyer offers across its global operations.

- **Travel Agencies (Traditional and Corporate)**

Amadeus supports over 100,000 travel agencies worldwide, acting as their core reservation system for booking and ticketing services.

- **Functions for Travel Agencies:17**

  - Access to global flight, hotel, car, rail, and cruise content in real time.
  - Ability to book, change, cancel, and revalidate tickets through Amadeus Selling Platform Connect.
  - Use of mid- and back-office tools for accounting, commission tracking, and customer profiles.

16 Amadeus IT Group. (2023). Amadeus airline IT solutions: Supporting global operations. Retrieved from https://amadeus.com/en/industries/airlines

17 Amadeus IT Group. (2022). How Amadeus empowers travel agencies and corporate travel platforms. Retrieved from https://amadeus.com

- Corporate agencies often integrate Amadeus with expense management and ERP systems.

Example: A corporate travel agency may use Amadeus to book multi-leg international itineraries with reporting tools for compliance and cost tracking.

- **Online Travel Agencies (OTAs)**

OTAs like Expedia, Booking.com, and regional platforms integrate Amadeus via APIs and web services to access flight schedules, seat availability, fare rules, and pricing.

- **OTA Integration Benefits:**

  - Real-time search and booking for end users.
  - Upsell of ancillaries (e.g., baggage, seat upgrades).
  - Integration with mobile applications and self-service features.
  - Reduced dependency on call centers through automation.

- **Technical Access Tools:**

  - Amadeus Travel APIs (REST/SOAP).
  - Amadeus for Developers Portal: Used to access sandbox environments, documentation, and commercial APIs.

1.10.2 System Integration and Industry Connectivity[18]

Amadeus ensures interoperability and consistency of services by aligning with global standards and protocols. This facilitates seamless integration with other systems and platforms across the travel industry.

- **IATA Interline and Code-Share Standards**

  - Enables travelers to book multi-airline itineraries under one ticket (e.g., Air France + Qatar Airways).
  - Supports ticket reconciliation, baggage handling, and seat confirmation across carriers.

- **New Distribution Capability (NDC)**

  - NDC is an IATA initiative for modernizing airline distribution.

18 Amadeus IT Group. (2023). Travel technology solutions for airlines, agencies, and online platforms. Retrieved from https://amadeus.com

- Amadeus is NDC Level 4 Certified, supporting rich content, dynamic offers, and ancillaries.
- Allows airlines to bypass traditional fare filing systems (like ATPCO) and send customized offers directly to agencies and OTAs.

➢ **Benefits of NDC in Amadeus:**

- Personalized offers based on customer profiles.
- Real-time fare construction without static pricing.
- Enables airlines to sell bundles like "Business Flex + Lounge Access + Extra Bag."

➢ **GDS Interconnectivity**

Although Amadeus competes with Sabre and Travelport (Galileo, Worldspan), there are cooperative frameworks in place:

- **Interline Booking Protocols**: Enable Amadeus to book and confirm segments from other GDS-hosted carriers.
- **Content Aggregation**: Via meta-search engines (like Google Flights or Skyscanner), which pull fare and availability data from multiple GDSs.
- **Multilateral Messaging Standards**: Uses EDIFACT and XML to synchronize data between platforms.

1.10.3 System Integration Architecture19

Component	Description	Protocols/Standards
Airline Systems	CRS, IMS, DCS (via Altéa or third-party)	EDIFACT, XML, REST APIs
Travel Agencies	Booking, ticketing, reporting	Amadeus Selling Platform, SOAP APIs
OTAs & Meta-Search	Dynamic fare search and bookings	REST APIs, NDC XML
Other GDSs	Data exchange, itinerary validation	Interline protocols, EDIFACT
Payment Processors	Ticketing and billing	PCI-DSS, BSP, ARC
Loyalty Systems	Points earning and redemption	Amadeus Loyalty Integration Layer

Table (1, 4): System Integration Architecture

19Amadeus IT Group. (2023). Open architecture and system integration for global travel platforms. Retrieved from https://amadeus.com

1.11 Importance of GDS Functionality Important[20]

- **Efficiency**: One platform to manage multiple suppliers and services.
- **Reach**: Extends the distribution network of airlines and hotels to a global audience.
- **Revenue Optimization**: Supports dynamic pricing, upselling, and loyalty integration.
- **Compliance**: Enables corporate policy enforcement and reporting.
- **Standardization**: Operates under IATA and industry standards for interoperability.

1.12 Conclusion

Chapter 01 established a strong theoretical foundation for understanding the Amadeus system within the broader context of airline and travel technology. Through its historical evolution, structural architecture, and strategic role in the industry, we observed how Amadeus has grown from a European reservation platform into a global travel technology leader. By analyzing its stakeholders, services, and integration with other systems, the chapter provided essential background knowledge needed to understand its technical and operational depth.

20 Sheldon, P. J. (1997). Tourism Information Technology. CABI Publishing pp. 59–78.

Chapter 02:
Core Architecture and Functional Simulation

Chapter 2

Core Architecture and Functional Simulation

2.1 Introduction

This chapter explores the technical backbone of the Amadeus system, focusing on its architecture, key functional modules, and operational flow. While Chapter 01 provided a theoretical foundation and industry context, this chapter delves into how Amadeus functions as a technological platform. It examines the structural components such as the Central Reservation System (CRS), Inventory Management System (IMS), and Fare and Pricing Modules, and shows how they interconnect to deliver efficient, scalable travel solutions. Additionally, the chapter highlights economic performance, training frameworks, and simulations to illustrate how Amadeus leads the market through innovation and integration.

2.2 Architecture of the Amadeus System

The architecture of the Amadeus system is a modular, scalable, and distributed system built to support the complex demands of the global travel industry. It consists of tightly integrated but independently operable components that handle reservation, inventory, pricing, and transaction processing.

2.2.1 Central Reservation System (CRS)21

The Central Reservation System is the core of Amadeus's infrastructure, acting as the central hub for managing bookings across multiple channels and suppliers.

- **Key Functions of the CRS:**

  - **PNR Creation and Management**:
    - Stores all travel-related information in a Passenger Name Record (PNR).
    - Manages booking updates, cancellations, itinerary changes, and special requests.

  - **Real-Time Availability**:

21 Amadeus IT Group. (2023). System architecture and reservation platform overview. Retrieved from https://developers.amadeus.com

    - Synchronizes with airline inventory in real time to provide accurate seat availability.
    - Ensures the latest schedule changes, disruptions, or flight delays are reflected.
- **Multi-Channel Access**:
    - **B2B**: Travel agencies and corporate systems via Amadeus Selling Platform.
    - **B2C**: Airline websites, mobile apps, and OTAs via APIs.
- **Transactional Integrity**:
    - Uses ACID-compliant database systems to ensure consistency across bookings and updates.
- **Scalability**:
    - Supports thousands of transactions per second with high availability and redundancy built into its architecture.

➢ **Technical Components:**

- **Amadeus Altéa Reservation**: A core part of the CRS for airline customers.
- Uses SOAP/XML APIs and increasingly RESTful APIs under the NDC (New Distribution Capability) standard.

2.2.2 Inventory Management System (IMS)22

The Inventory Management System (IMS) is responsible for managing an airline's seat inventory, which includes:

- Flight segments
- Seat maps
- Cabin classes
- Booking class codes (RBDs: Reservation Booking Designators)

➢ **Key Capabilities of the IMS:**

- **Real-Time Seat Tracking**:
    - Tracks seat assignments and updates availability as bookings are made, canceled, or changed.
    - Integrates with the Departure Control System (DCS) for check-in and boarding.
- **Cabin and Class Control**:
    - Manages inventory across different fare classes (e.g., Y, M, Q, J, C).
    - Enforces class limits to avoid overbooking.
- **Class Mapping and Overbooking Management**:
    - Airlines may overbook certain classes based on historical no-show data.

22 Amadeus IT Group. (2023). Airline inventory management and distribution solutions. Retrieved from https://amadeus.com

    - The IMS works with revenue management systems to determine acceptable limits.
- **Schedule Change Propagation**:
    - Automatically updates PNRs and informs passengers/agents of time changes or cancellations.

➢ **Integration with Other Modules:**

- Works closely with:

    - **Revenue Management Systems (RMS)**: Suggests how many seats to sell at each price level.
    - **CRS**: To ensure availability is reflected during booking.
    - **GDS Distribution Engine**: For content delivery to travel agencies.

2.2.3 Fare and Pricing Module23

The Fare and Pricing Module handles one of the most complex areas of airline operations—calculating the cost of travel and applying correct pricing logic.

➢ **Main Functions:**

- **Fare Retrieval and Validation**:
    - Retrieves published and negotiated fares from airline-hosted and third-party databases.
    - Applies validation rules based on:
        - **Routing** (origin-destination pairs).
        - **Date/Time** constraints (e.g., minimum stay, maximum stay).
        - **Advance Purchase** rules.
- **Tax and Fee Calculation**:
    - Automatically includes country, airport, and fuel surcharges.
    - Updates with the latest IATA and government-imposed changes.
- **Discounts and Corporate Agreements**:
    - Applies special corporate, group, or frequent flyer discounts.
    - Supports fare basis codes linked to eligibility rules.

➢ **Integration with Standards and Data Sources:**

- **ATPCO (Airline Tariff Publishing Company)**:
    - Provides global fare distribution and filing standards.
    - Amadeus integrates directly with ATPCO for up-to-date fare content.
- **IATA Pricing Rules**:
    - Ensures global compliance with airline tariff and pricing policies.

23 Amadeus IT Group. (2023). Airline pricing, fares, and revenue optimization solutions. Retrieved from https://amadeus.com

- **Dynamic Pricing and Personalization:**
  - Uses AI and machine learning to offer personalized pricing (e.g., based on customer profile, search history, time of day).
  - Supports fare families and branded fares (e.g., Economy Light, Flex, Business Premium).
- **Output Integration:**
  - Feeds data to:
    - The ticketing system (e.g., for pricing and fare basis codes).
    - The payment gateway (to process the final amount).
    - The analytics module (for sales and revenue tracking).

2.2.4 System Infrastructure Overview[24]

Component	Primary Role	Integration
CRS	Booking and PNR management	IMS, Pricing, GDS
IMS	Seat and class inventory	CRS, DCS, RMS
Pricing Module	Fare calculation	ATPCO, IATA, CRS
GDS	Content distribution	Travel agents, OTAs
Altéa Suite	End-to-end airline IT	Airlines (B2B)
APIs (SOAP, REST)	Developer access and integration	Airlines, OTAs, meta-search

Table (2, 1): System Infrastructure Overview

24 Amadeus IT Group. (2023). Amadeus system architecture: Component integration and platform overview. Retrieved from https://developers.amadeus.com

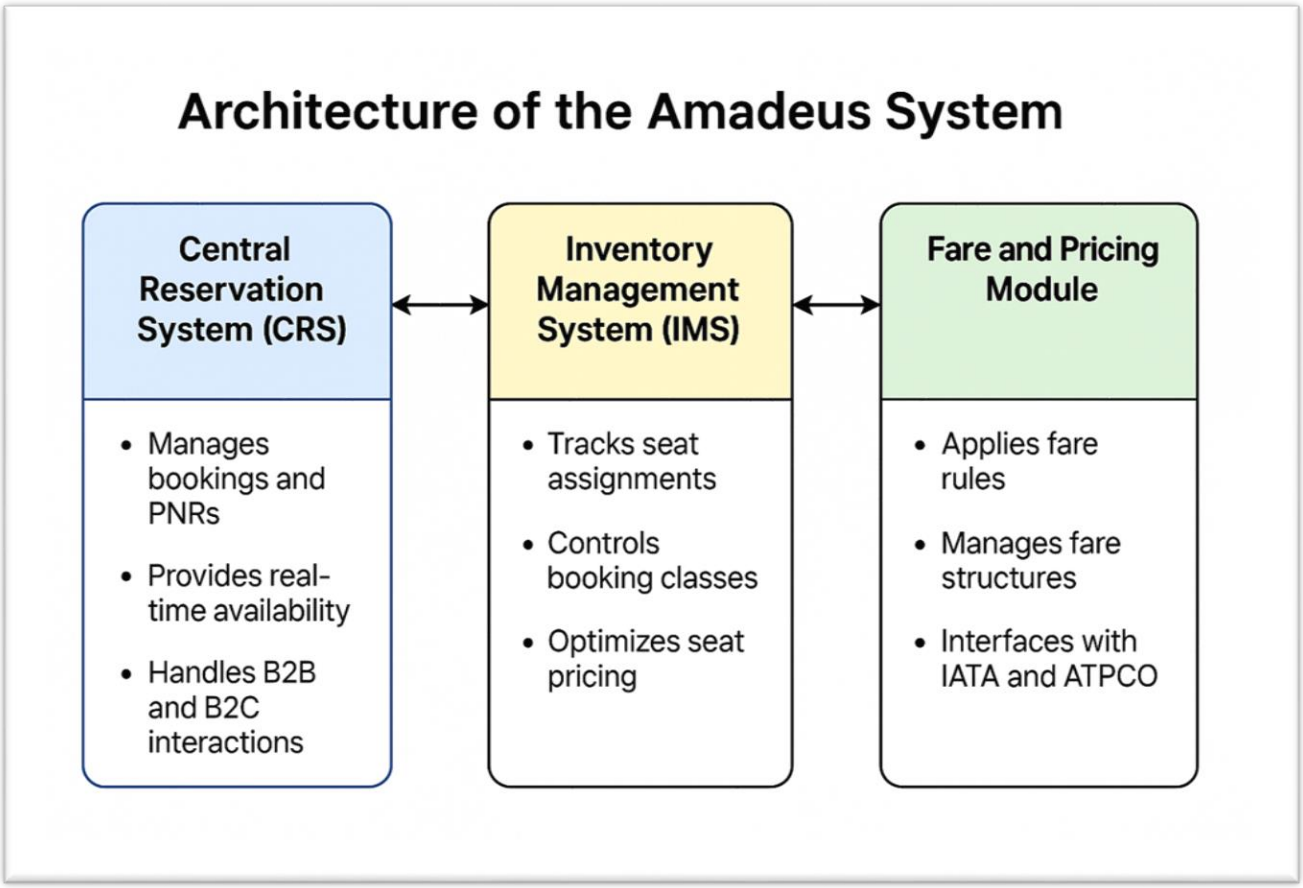


Figure (2, 1): Architecture of the Amadeus system

2.3 Core Functionalities of the Amadeus System[25]

Amadeus delivers a wide range of functionalities that serve multiple actors in the travel and airline ecosystem. These functionalities are tightly integrated to ensure seamless transactions, data consistency, and real-time processing.

2.3.1 Flight Reservations

At the heart of Amadeus's GDS lies the flight reservation engine, designed to facilitate end-to-end itinerary creation and management.

- **Key Capabilities:**

25 Amadeus IT Group. (2023). Flight booking and seat management solutions. Retrieved from https://amadeus.com

- **Flight Search**:
  - Users can search flights by parameters such as:
    - Origin/Destination
    - Departure/Return dates
    - Airline preference
    - Cabin class
    - Flexible date ranges
  - Search results are ranked using availability, pricing, and fare rules.
- **Dynamic Availability**:
  - Real-time synchronization with airline inventory systems.
  - Updates immediately when bookings, cancellations, or changes occur.
- **Instant Booking Confirmation**:
  - Once selected, the itinerary is confirmed instantly and stored in the Passenger Name Record (PNR).
  - Confirmed bookings are sent to the airline and stored for ticket issuance.
- **Modifications and Cancellations**:
  - Users or agents can modify PNRs (e.g., flight time, routing, passenger details).
  - Includes re-pricing logic and change penalty assessment.
  - Cancellation policies are governed by fare rules, which are enforced automatically.

2.3.2 Seat Allocation

Amadeus enables interactive seat selection, optimizing passenger comfort and revenue generation for airlines.

- **Seat Allocation Features:**

- **Interactive Seat Maps**:
  - Visual seat maps show real-time availability.
  - Passengers can select or change their seat during or after booking.
- **Automatic Assignment**:
  - Default logic based on:
    - Passenger status (e.g., loyalty tier)
    - Fare class (e.g., Economy Flex vs. Basic)
    - Group or family bookings (to seat together)
- **Seat Upselling**:
  - Airlines can monetize premium seating options:
    - Extra legroom
    - Window/aisle preference
    - Front-row access
  - Seamlessly integrated into booking flow (especially for LCCs and hybrid carriers).
- **Post-Booking Seat Management**:
  - Passengers can manage seats via airline websites, mobile apps, or check-in kiosks (all powered by Amadeus APIs).

2.3.3 Ticket Issuance and Payment Processing

Ticketing is a critical part of the reservation cycle. Amadeus automates and streamlines this process, ensuring compliance with industry standards and secure payment handling.

- **Ticketing Process:**

  - **E-Ticket Generation**:
    - Upon confirmation and fare calculation, an e-ticket (ET) is automatically issued.
    - Each ticket is linked to a PNR and stored in the airline's DCS and accounting systems.
    - Compatible with IATA's Electronic Ticketing (ET) standards.
  - **Fare & Tax Calculation**:
    - Automatically applies:
      - Base fare
      - Airport and government taxes
      - Fuel and carrier-imposed surcharges (YQ/YR)
    - Validates fare construction using ATPCO fare rules.
  - **Payment Integration**:
    - Secure connections with:
      - Credit/Debit cards (Visa, Mastercard, Amex)
      - Digital wallets (Apple Pay, PayPal)
      - Bank transfers and virtual cards (B2B payments)
    - PCI-DSS compliant for secure data handling.
  - **Multi-Ticketing Support**:
    - Capable of issuing:
      - Single-leg
      - Round trip
      - Multi-airline and interline tickets
    - Revalidations and reissuance supported without manual intervention.

2.4 Business and Global Impact26

Amadeus is not just a booking engine; it is a technology backbone for the global travel ecosystem. Through its integrated IT solutions, Amadeus enables airlines and travel stakeholders to streamline operations, improve customer service, and enhance profitability. Its influence spans multiple dimensions — technological, economic, and environmental.Amadeus equips airlines with a fully integrated IT suite, enabling seamless coordination between sales, operations, and customer management.

26 Amadeus IT Group. (2023). Airline IT solutions: Optimization, Altéa Suite, and analytics platforms. Retrieved from https://amadeus.com

2.4.1 Optimization Tools & Decision Support

- **Demand Forecasting & Capacity Management**

  - Utilizes historical data and machine learning models to predict travel demand by route, season, or event.
  - Enables proactive adjustment of fleet size and flight frequency.

- **No-show & Overbooking Strategies**

  - Uses predictive analytics to estimate no-show rates.
  - Supports smart overbooking policies to maximize seat occupancy while minimizing denied boardings.

2.4.2 Altéa Suite – Core Airline Management Platform

Amadeus's Altéa Suite integrates critical operations:

- **Altéa Reservation**
  Manages flight bookings, PNR creation/modification, and customer profiles across channels.
- **Altéa Inventory**
  Controls fare classes, seat availability, and code-share configurations in real time.
- **Altéa Departure Control System (DCS)**
  Automates check-in, boarding, weight/balance calculations, and last-minute upgrades.

Benefits: Faster boarding, fewer delays, better load distribution, real-time updates to flight crew and operations.

2.4.2 Resource Management & Ground Operations

- **Crew & Gate Management**
  Predictive scheduling systems reduce delays caused by crew unavailability or gate conflicts.
- **Turnaround Optimization**
  Monitors aircraft cleaning, catering, refueling, and boarding for quicker turnaround.
- **Integrated Airport Data Exchange**
  Enables real-time communication with airport systems for seamless processing of:
  - Baggage handling
  - Passport/visa validation
  - Boarding pass scanning

2.4.3 Business Intelligence and Analytics

Amadeus Analytics provides custom dashboards and reporting tools for:

- Route profitability analysis

- Ancillary revenue tracking (e.g., seat upgrades, luggage fees)
- Conversion funnel analysis on booking platforms

Customer behavior segmentation (e.g., loyalty vs. first-time flyers)

2.5 Future Trends and Expansion Plans27

Amadeus is at the forefront of digital transformation in travel. It continues to evolve through strategic initiatives in cloud computing, artificial intelligence, sustainability, and global market penetration.

2.5.1 AI & Machine Learning Integration

- **Dynamic & Personalized Pricing**
  - Real-time pricing engines adjust fares based on:
    - User behavior (loyalty, browsing habits)
    - Market competition
    - Booking timing and destination
- **Conversational AI & Chatbots**
  - Deployed on airline and OTA websites to:
    - Answer FAQs
    - Handle bookings and cancellations
    - Suggest upsell opportunities (e.g., extra luggage, lounge access)
- **Fraud Detection and Risk Scoring**
  - AI-driven transaction analysis to flag suspicious patterns.
  - Includes device fingerprinting, behavioral biometrics, and geo-location matching.

2.5.2 Carbon Emissions Tracking & Reporting

Amadeus integrates advanced sustainability features to support airlines and passengers in reducing their environmental footprint. These tools enhance transparency and compliance with international climate regulations.

27 Amadeus IT Group. (2023). Airline IT solutions: Optimization, Altéa Suite, and analytics platforms. Retrieved from https://amadeus.com

- **Emissions Visibility**

  - Displays CO_2 emissions per passenger during flight search.
  - Helps customers make eco-conscious decisions (e.g., choose flights with newer aircraft).

- **Regulatory Compliance**

  - Supports reporting under frameworks such as:
    - EU ETS (Emission Trading System)
    - CORSIA (Carbon Offsetting and Reduction Scheme for International Aviation)

- **Carbon Offset Integration**

  - Allows travelers to voluntarily offset their emissions directly within the booking flow.

2.5.3 Cloud Transformation and Geographic Expansion

- **Cloud Transformation:Partnership with Microsoft Azure**

  - Migrating core systems and databases to cloud architecture.
  - Delivers:
    - High availability (HA) for global deployments.
    - Elastic scalability during seasonal peaks.
    - Lower infrastructure costs for hosted airlines.
  - Use Case: Airlines can now roll out new digital features faster without major hardware upgrades.

- **Geographic Expansion Initiatives**

  - **Asia-Pacific (APAC)**

    - Collaborations with AirAsia, China Eastern, and IndiGo.
    - Focus: Mobile-first solutions and payment localization.

  - **Latin America**

    - Strengthening GDS presence and supporting regional carriers with Altéa-hosted systems.

  - **Africa**

    - Enabling low-cost carriers (LCCs) with modular IT solutions.
    - Working with governments on smart border control and e-visa integrations.

2.6 Economic Aspect of Amadeus28

Amadeus IT Group plays a significant economic role in the global travel and tourism industry. Its business model, financial performance, and broader economic impact span multiple sectors, including aviation, hospitality, government, and fintech.

2.6.1 Business Model and Revenue Streams

Amadeus operates with a hybrid business model that combines Global Distribution System (GDS) services with Software-as-a-Service (SaaS) and enterprise IT solutions.

Key Revenue Segments:

Revenue Stream	Description
Distribution	Fees from airlines and travel sellers per booking via the GDS.
IT Solutions	Recurring revenue from Altéa Suite, Navitaire, hotel/rail software, etc.
Professional Services	Consulting, training, and implementation services for travel companies.
Software Licensing	Licensing proprietary solutions to airports, border control, etc.
Advertising and Data	Revenue from targeted ads and data analytics solutions.

Table (2, 2): Key Revenue Segments

Distribution contributes 60%, and IT solutions 40% of Amadeus's total revenue. The company's diversification across segments ensures financial resilience.

2.6.2 Economic Impact on Stakeholders

- **Airlines**

  - Reduces distribution and marketing costs via GDS exposure.
  - Enables ancillary revenue generation (e.g., baggage fees, seat upgrades).
  - Optimizes flight operations through predictive analytics.
  - Supports sustainable growth with emissions tracking tools.

28 Amadeus IT Group. (2023). Annual report and financial highlights 2023: Business strategy and economic impact. Retrieved from https://amadeus.com

➢ Travel Agencies & OTAs

- Centralized access to real-time inventory of flights, hotels, car rentals.
- Supports dynamic packaging and upselling.
- Reduces technology infrastructure costs by using Amadeus-hosted platforms.
- Improves customer satisfaction with faster response times and personalization.

➢ Tourism Economy

- Facilitates global travel demand by supporting multi-currency, multilingual transactions.
- Contributes to employment in aviation, hospitality, and tour operations.
- Expands market access for regional and low-cost carriers.
- Enables better tourism planning through market insights and booking trends.

2.6.3 Global Economic Footprint

- Present in 190+ countries with over 19,000 employees.
- Listed on the Spanish Stock Exchange (IBEX 35).
- Invests over €1 billion annually in research and development.
- Operates data centers and tech hubs across Europe, the Americas, and Asia.
- Economic driver in tech hubs such as Nice, Madrid, Bangalore, and Miami.
- Partnerships with local governments and institutions to foster digital talent.

2.7 Financial Analysis and Resilience[29]

Amadeus IT Group's financial ecosystem reflects its strategic positioning as a global technology leader in the travel and tourism industry. With a robust and resilient revenue model, diversified services, and aggressive investment in innovation, Amadeus continues to thrive economically, supporting its stakeholders while driving digital transformation.

2.7.1 Financial Performance Highlights

- Annual Revenue (pre-COVID): ~€5.5 billion; recovering steadily post-pandemic.
- EBITDA Margin: 35–40%, reflecting high operating efficiency.
- Booking Volume: over 600 million-air bookings/year, excluding non-air segments.
- Market Capitalization: Among top European technology firms.
- Diversified geographic earnings reduce dependency on a single market.

29 Amadeus IT Group. (2023). Annual Report 2022–2023: Financial performance and strategic overview. Retrieved from https://amadeus.com

Resilient business model with recurring revenue from long-term IT service contracts. Strong cash flow generation supports reinvestment and shareholder returns.

Metric	Value (2023)
Revenue	~€5.4 billion
Net Income	~€1.1 billion
EBITDA	~€2.0 billion
EBITDA Margin	~37%
Free Cash Flow	~€1.3 billion
R&D Investment	~€1.1 billion
Employees	~19,000
Market Capitalization	~€30 billion
Countries Served	190+

Table (2, 3): Financial Performance Highlights

Amadeus maintains strong liquidity and consistently pays dividends to shareholders while investing heavily in infrastructure and innovation.

- **Revenue Model and Segments**

Amadeus operates a B2B-centric model with strong recurring income from transaction-based and subscription-based services.

- **Revenue Breakdown (2023 Estimates):**

Revenue Stream	Description	Approx. Share
Distribution	Income from flight/hotel bookings through GDS. Airlines and agencies pay per booking.	58%
IT Solutions	Includes Altéa Suite, Navitaire, airport management, hospitality software.	35%
Other Services	Professional services, software licensing, advertising, data analytics.	7%

Table (2, 4): Revenue Breakdown (2023 Estimates)

- **Revenue Characteristics:**

  - High scalability due to cloud and API infrastructure.
  - Pricing is usually per transaction or via multi-year licensing contracts.
  - Strong seasonality around summer travel and holiday peaks.

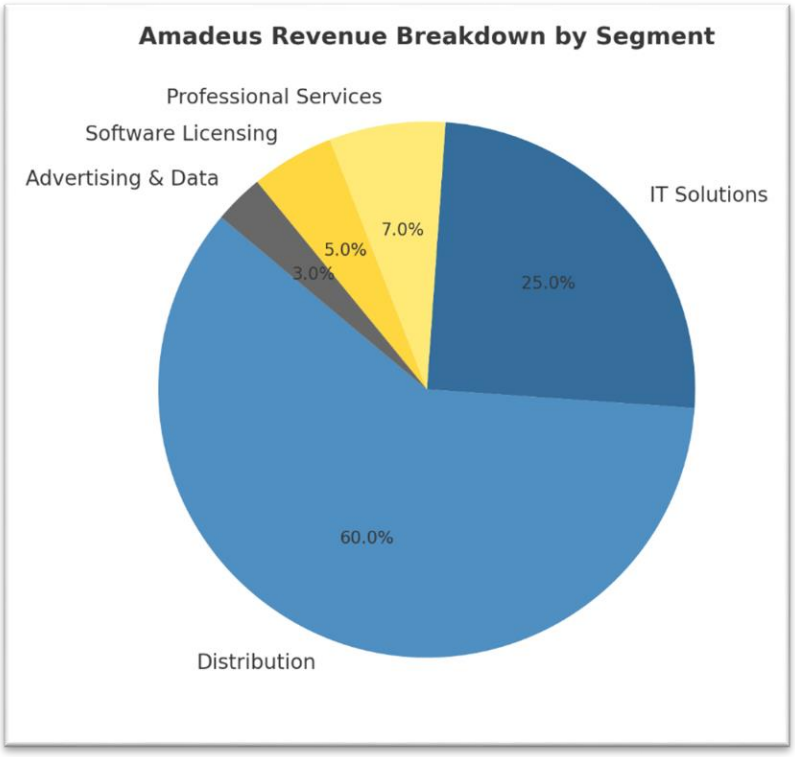


Figure (2, 2): Amadeus revenue breakdown by segment

2.7.2 Post-Pandemic Recovery & Resilience

- **Impact of COVID-19:**

  - 2020 revenue dropped by over 60%.
  - Operational losses were absorbed without bankruptcy or major layoffs.

- **Recovery Strategy:**

  - Shifted to cloud infrastructure for cost efficiency.
  - Expanded into non-airline verticals: rail, hospitality, car rentals.
  - Increased focus on contactless solutions and travel safety tech.

- By 2023, Amadeus had not only recovered pre-pandemic revenue but also exceeded it in high-margin services like data analytics and hospitality IT.

➢ **Post-COVID Economic Recovery Role**

- Enables safe travel with features like contactless check-in, health documentation integration, and AI-based forecasting.
- Assists governments and airlines in scaling operations to meet recovery demands.
- Strengthens economic recovery by supporting efficient travel resumption.
- Offers crisis-resilient infrastructure through its cloud-based platforms.
- Drives regional connectivity and domestic travel recovery in underserved markets.

2.7.3 Role in Digital Economy and Innovation

- Promotes digitization across the travel supply chain.
- Drives fintech capabilities including:
  - Real-time dynamic pricing
  - Fraud detection systems
  - Integrated multi-channel payments
  - Buy now, pay later (BNPL) models for travel purchases
- Open API infrastructure allows developers to create innovative travel solutions.
- Contributes to the EU's digital economy objectives and sustainability goals.

2.8 Strategic Investments and Financial Strategy30

2.8.1 Global Economic Contributions

➢ **Direct Economic Value:**

- Pays taxes in all major operating regions.
- Boosts local economies through office operations in Spain, France, India, and the U.S.
- Funds regional R&D centers that support local innovation.

➢ **Indirect Value:**

- Empowers small travel agencies globally via platform access.
- Supports airlines in developing economies by offering hosted IT solutions.

30 Amadeus IT Group. (2023). Sustainability and investment report: Strategic growth and global economic impact. Retrieved from https://amadeus.com

- Facilitates millions of travel bookings that contribute to tourism GDP globally.

2.8.2 Strategic Investments & Acquisitions

Year	Acquisition/Investment	Purpose & Impact
2015	**Navitaire**	Expanded LCC (low-cost carrier) solutions
2018	**TravelClick**	Entered hotel software market
2021	**Microsoft Azure Deal**	Shifted IT infrastructure to the cloud for efficiency
2023	**Fintech Startups**	Introduced AI pricing, travel lending, and risk modeling

Table (2, 5): Strategic Investments & Acquisitions

These acquisitions expanded Amadeus's capabilities across air, rail, hospitality, and fintech, increasing cross-segment revenue opportunities.

2.8.3 Investor Confidence & Ratings

- **Credit Rating**: BBB (Standard & Poor's) – Stable outlook
- **Dividend Policy**: Regular annual dividends with buyback programs
- **Stock Index**: Listed on IBEX 35 (Madrid Stock Exchange)
- **Governance**: High compliance with EU and global ESG standards

Amadeus enjoys long-term investor confidence due to stable cash flows, innovation leadership, and effective corporate governance.

2.8.4 Long-Term Financial Strategy

- **Digital-First Business Model**: Moving all services toward cloud and API-based delivery.
- **SaaS Licensing Growth**: Replacing fixed contracts with scalable cloud-based subscription models.
- **Geographic Diversification**: Increased investment in Latin America, Africa, and APAC markets.
- **Sustainability Financing**: Introducing green bonds and ESG-linked investment channels.

2.9 Amadeus Training and Education31

31 Amadeus Learning Universe. (2023). Course catalog: GDS and Altéa training programs for travel professionals. Retrieved from https://learning.amadeus.com

Training on the Amadeus system is essential for travel professionals, airline staff, and IT specialists who interact with the platform daily. Amadeus offers a robust and structured learning environment to help users maximize the system's capabilities across its many modules.

2.9.1 Objectives of Amadeus Training

- Build user proficiency in using the Amadeus GDS interface.
- Enable efficient management of flight bookings, ticketing, and customer service.
- Equip airline and airport staff with specialized knowledge of Altéa systems.
- Train travel agents on dynamic packaging, fare construction, and itinerary handling.
- Improve productivity, reduce errors, and enhance service quality.

2.9.2 Training Categories

A. Foundational Training (Entry-Level)

- **GDS Basics**: Navigation, command entries, help functions.
- **Flight Availability & Booking**: How to find flights, enter PNRs, and handle waitlists.
- **PNR Management**: Updates, cancellations, SSRs (Special Service Requests).

B. Advanced & Professional Courses

- **Fare Calculation**: Using published fares, CAT rules, validating carriers.
- **Ticketing**: E-ticket issuance, reissues, refunds, voids.
- **Queue Management**: Workflow management through queues.
- **Ancillary Services**: Seat selection, baggage, lounge access.

C. Specialized Airline Training

- **Altéa Suite Modules**:
    - Altéa Reservation (RES)
    - Altéa Inventory (INV)
    - Altéa Departure Control (DCS)
- **Airport System Interface (ASI)**
- **Weight and Balance Tools**

D. Hospitality and Rail Training

- Hotel and car rental reservation systems
- Rail bookings via Amadeus Rail Tools

2.9.3 Training Methods

Method	Description
e-Learning Modules	Self-paced, interactive training via Amadeus Learning Universe
Classroom Training	Instructor-led sessions at certified centers
Virtual Instructor-Led	Live Zoom/Teams sessions with certified trainers
Simulated Labs	GDS simulators to replicate real-time environment
Mobile Learning	Access to micro-learning and refresher modules on smartphones and tablets

Table (2, 6): Training Methods

2.9.4 Tools & Platforms

Amadeus Learning Universe (ALU)

- Online LMS platform
- Personalized learning paths
- Progress tracking and certification

Simulators

- Emulates Amadeus command-line interface (Cryptic)
- Used for real-world exercises and troubleshooting scenarios

Workshops & Certifications

- Short-term bootcamps
- Workshops for NDC, ONE Order, Farelogix, etc.

2.9.5 Popular Certifications

Certification Name	Description
Amadeus Basic Reservation	Entry-level GDS usage
Amadeus Advanced Ticketing	Fare construction and multi-sector ticketing
Amadeus Altéa DCS Certification	For airport and check-in agents
Amadeus Hotel & Car Booking	For travel agents working on full itinerary services
Amadeus Business Travel Specialist	Focused on corporate travel agencies and TMCs

Table (2, 7): Popular Certifications

These certifications improve employability and are often required by airlines, tour operators, and large travel corporations.

2.9.6 Course Duration & Pricing

Course Type	Duration	Approximate Cost (EUR)
Basic GDS Course	2–4 weeks	€150 – €250
Advanced Fare/Ticketing	3–6 weeks	€300 – €500
Altéa Suite Training	1–2 months	€500 – €1,000+
Hospitality Add-ons	1–2 weeks	€100 – €300

Table (2, 8): Course Duration & Pricing

Note: Prices may vary based on location, provider, and training level.

2.9.7 Where to Get Amadeus Training

- Amadeus Official Partners (e.g., Amadeus Learning Universe)
- Accredited Travel Academies and Vocational Schools (e.g., IATA centers)
- E-learning platforms (e.g., Udemy, Coursera – basic courses)
- Universities offering Tourism or Aviation Programs

2.9.8 Benefits of Amadeus Training

- Enhanced career opportunities in airlines, travel agencies, and airports
- Improved customer satisfaction due to better booking accuracy

- Boosted confidence and productivity of travel professionals
- Compliance with airline and regulatory standards (IATA, ICAO)
- Competitive advantage in tourism and aviation job markets

2.10 Why choose Amadeus?

Why Choose Amadeus Over Other Booking Platforms[32]

Amadeus stands out among Global Distribution Systems (GDS) and travel technology platforms due to its advanced capabilities, market penetration, and strategic value for both travel providers and sellers. Here's a breakdown of the key differentiators:

2.10.1 Global Market Leadership & Versatility

- Presence in over 190 countries with strong market share in Europe, Middle East, Africa, and Asia-Pacific.
- Supports more than 440 airlines, 100,000+ travel agencies, and over 90 airport ground handling companies.
- Offers multi-modal booking capabilities (air, rail, cruise, hotel, car, insurance) all from a single platform.

Example: A travel agency can use Amadeus to book an international flight, a high-speed train in Europe, a rental car, and a hotel—all in one transaction.

2.10.2 Powerful and Modern Technology Stack

- **Cloud-Native Infrastructure**: Through its partnership with Microsoft Azure, Amadeus ensures high availability, scalability, and low latency.
- **AI & Machine Learning**: Enables smart features like predictive pricing, fraud detection, and user-behavior analytics.
- **New Distribution Capability (NDC)**: Fully supports IATA's XML-based standard to enable richer airline offers (e.g., seat upgrades, meals, ancillaries).

Competitive Edge: Sabre and Travelport also support NDC, but Amadeus has a broader network of NDC-enabled airline integrations.

32 Amadeus IT Group. (2023). Corporate capabilities: Technology, training, partnerships, and sustainability. Retrieved from https://amadeus.com

2.10.3 Superior System Integration (Altéa Suite)

Amadeus's Altéa Suite connects reservation, inventory, and departure control into a single, synchronized platform for airlines.

Module	Function
Altéa Reservation	Manages flight bookings and PNRs
Altéa Inventory	Controls availability and booking class distribution
Altéa Departure Control	Manages check-in, baggage, and boarding

Table (2, 9): Superior System Integration (Altéa Suite)

Used by major airlines like Lufthansa, Air France, Singapore Airlines, Qatar Airways, etc.

2.10.4 Enterprise & B2B Tools

- **Amadeus Selling Platform Connect**: A modern web-based booking engine with both cryptic (command-line) and graphical interfaces.
- **Travel Intelligence**: Tools that provide real-time analytics for travel businesses to monitor booking trends, customer behavior, and market demand.

Insight: Travel agencies and corporate travel managers benefit from detailed dashboards and real-time decision-making.

2.10.5 Comprehensive Training & Certification Ecosystem

- Amadeus Learning Universe (ALU) offers certifications in:
  - Reservation and Ticketing
  - Altéa Systems
  - Business Travel Management
- Provides e-learning, virtual classrooms, live simulators, and hands-on labs.

Benefit: A better-trained workforce increases efficiency and reduces error rates.

2.10.6 Security, Compliance, and Environmental Responsibility

- Compliant with:
  - PCI-DSS (Payment Card Security)
  - IATA & ICAO regulations
  - EU GDPR for data protection
- CO_2 Tracking Tools integrated into booking systems to help airlines and agencies meet sustainability goals (CORSIA, EU ETS).

Sustainability-focused innovation is increasingly vital for modern travel organizations.

2.10.8 Strategic Industry Partnerships

- Partners with Microsoft, Lufthansa Group, Iberia, AirAsia, LATAM, and others.
- Invests in travel startups and innovation hubs to stay at the forefront of travel tech.
- Works closely with government travel and tourism ministries (especially in Europe and Africa).

Comparative Table – Amadeus vs. Competitors

Feature / Platform	Amadeus	Sabre	Travelport (Galileo/Worldspan)
Cloud Integration	✓ Azure	AWS	AWS
Altéa Suite	✓ Native	✗	✗
NDC Support	✓ Full	Partial	Partial
CO_2 Tracking & Offsetting	✓ Built-in	Limited	Limited
Travel Package Support	✓ Strong	Moderate	Moderate
Multimodal Bookings	✓ Strong	Weak	Moderate
Training Infrastructure	✓ Strong	Moderate	Weak

Table (2, 10): Comparative Table – Amadeus vs. Competitors

Final Thoughts

Choosing Amadeus provides:

- A future-proof platform with integrated tech and continuous innovation.
- Broader capabilities for global and local travel markets.
- Better service, stronger analytics, and more personalization opportunities.

2.11 Detailed Booking Workflow in Amadeus33

2.11.1 Codage (Encoding the Transaction)

33 Amadeus for Developers. (2023). Airline booking workflow and API documentation. Retrieved from https://developers.amadeus.com

The booking process starts with user intent. This must be encoded into a structured format (commands, data, API calls) that the Amadeus system can understand.

Step 1: Search for Availability

Agent/User Intent: Find available flights from Algiers (ALG) to Paris (CDG) on 10 September.
Encoding:

- **Cryptic Command:** `AN25JULCZLALG/AAH`

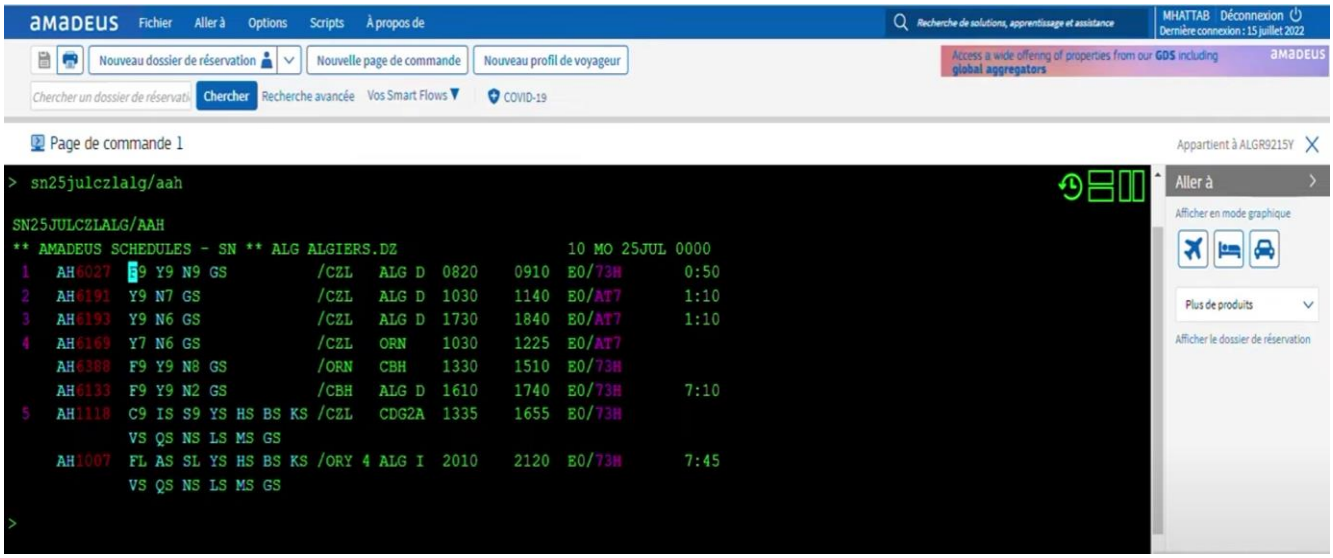


Figure (2, 3): Available flights

How it works:

- The GDS interprets this encoded input by querying airline databases for seat availability.
- The input is standardized according to EDIFACT, IATA, and Amadeus message protocols.

Step 2: Flight Selection

Commands:

- Segment sell: *SS1Y1* – Sell 1 seat in Y class on segment 2

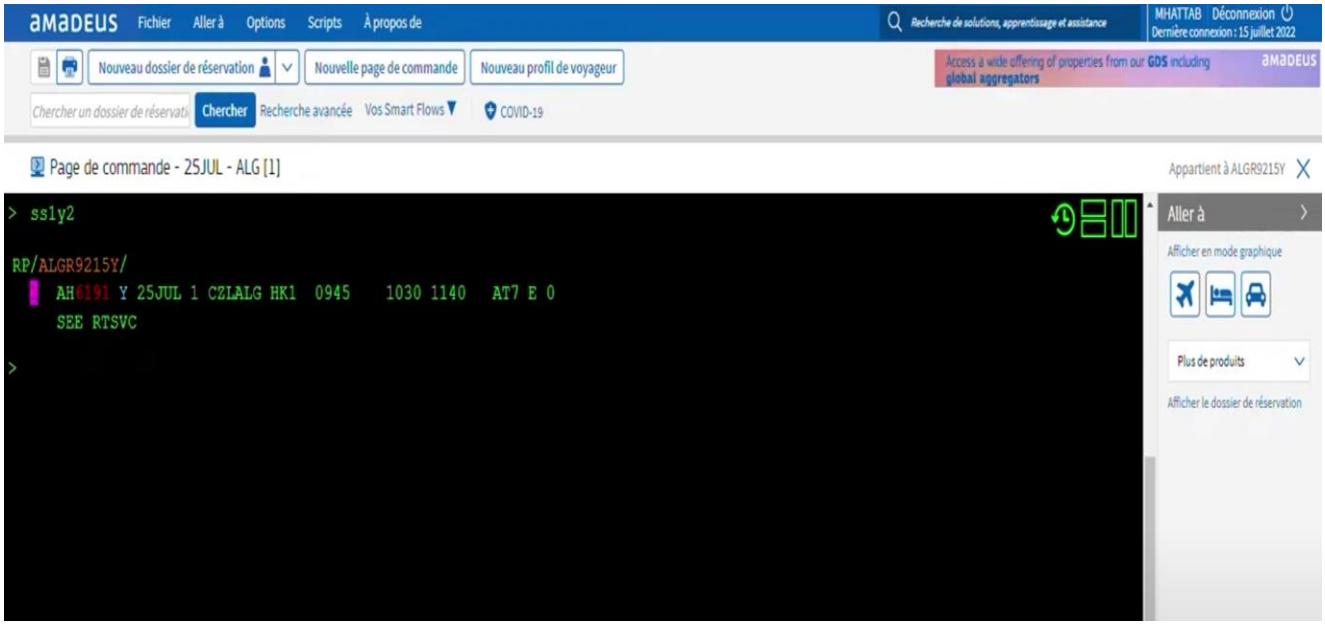


Figure (2, 4): Flight Selection

Step 3: Create PNR (Passenger Name Record)

Encoding (Commands):

- Name: `NM1CHABANE/SAId`

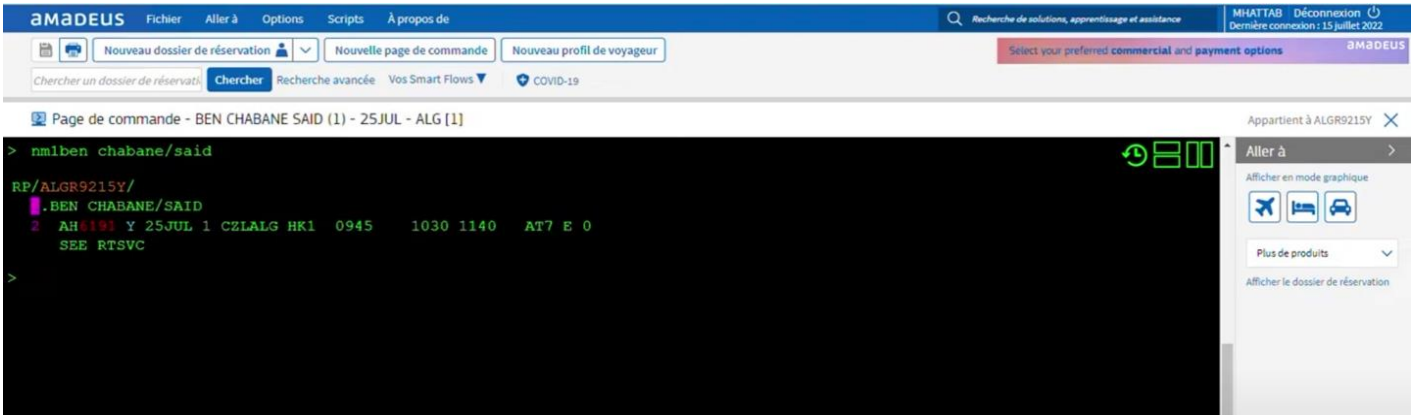


Figure (2, 5): Passenger Name

- Phone: `AP0606225252`

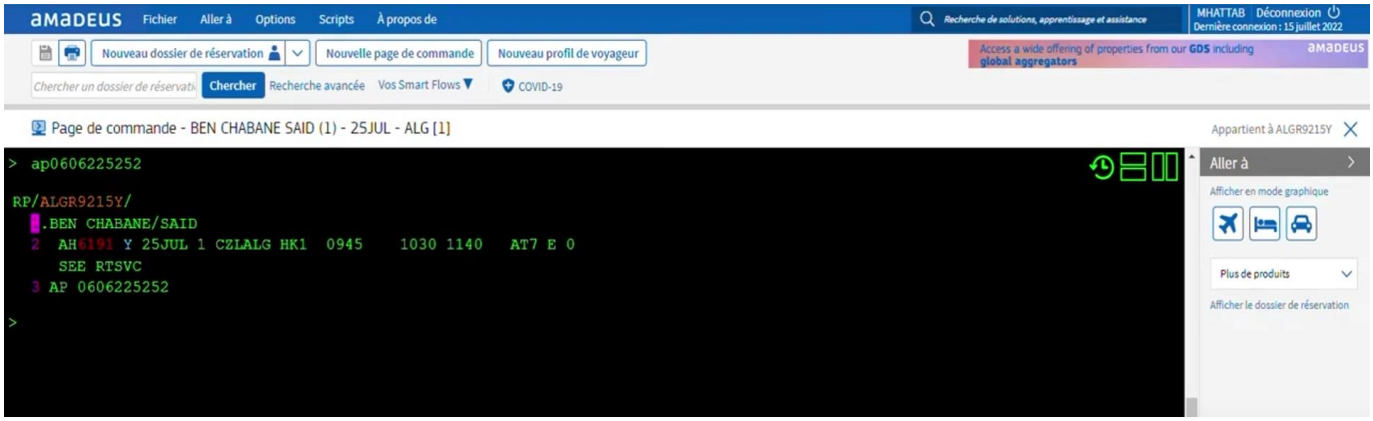


Figure (2, 6): Phone of passenger

- Email: `APE-ISSAMBOUDRA25@GMAIL.COM`

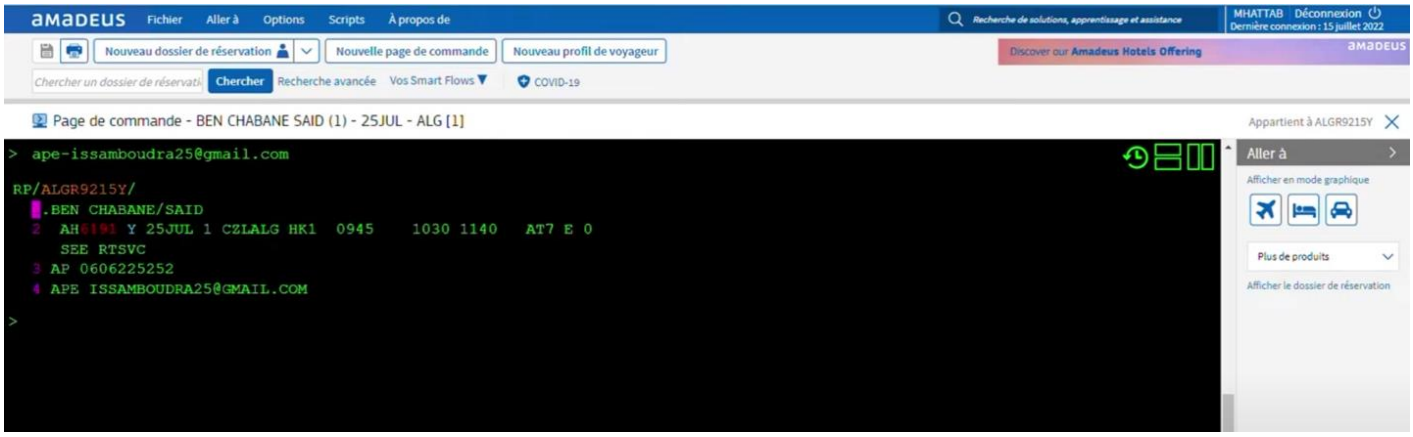


Figure (2, 7): Email of passenger

- Ticket ok : `TKok`
- End of Record: `er`

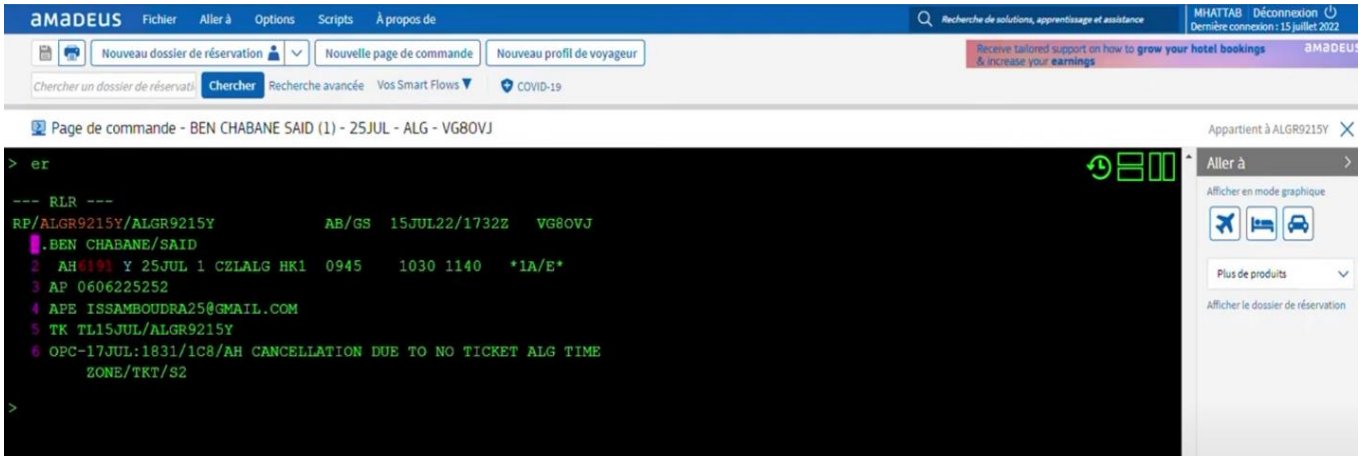


Figure (2, 8): Ticket ok and end of record

- **Step 4: Pricing & Ticketing**

Encoding:

- Price the itinerary: `FXP` or `FXB`

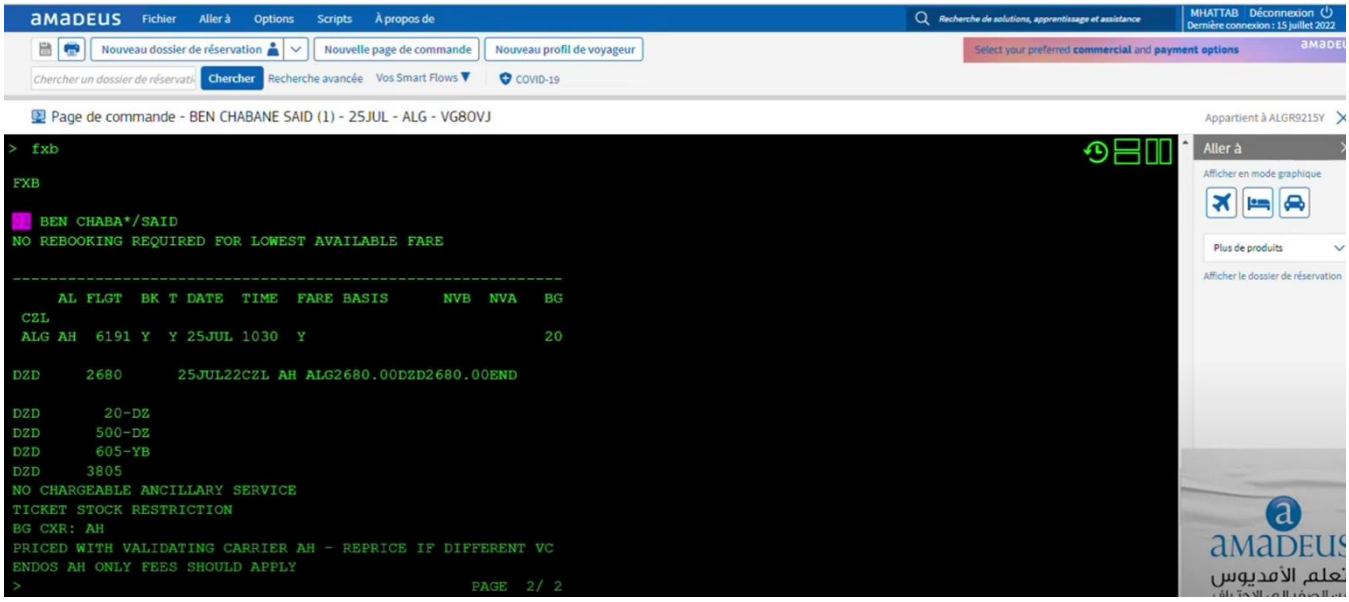


Figure (2, 9): Price the itinerary

- Payment method : fpcash

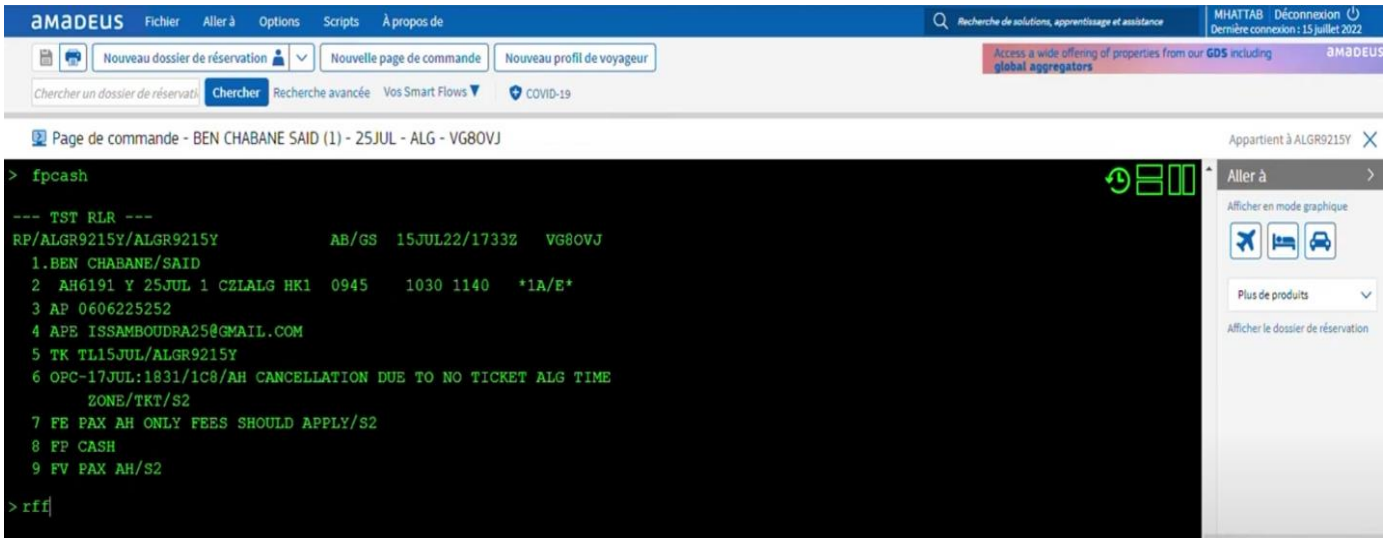


Figure (2, 10): Payment method

- signature: `rff`

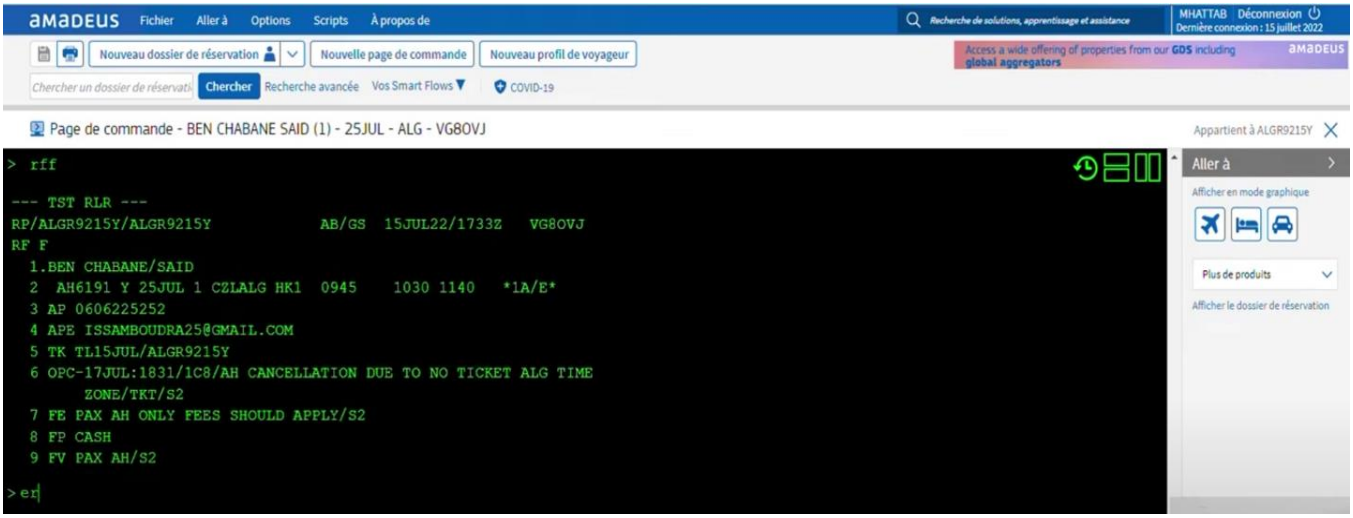


Figure (2, 11): Signature

- Issue ticket: `TTP`

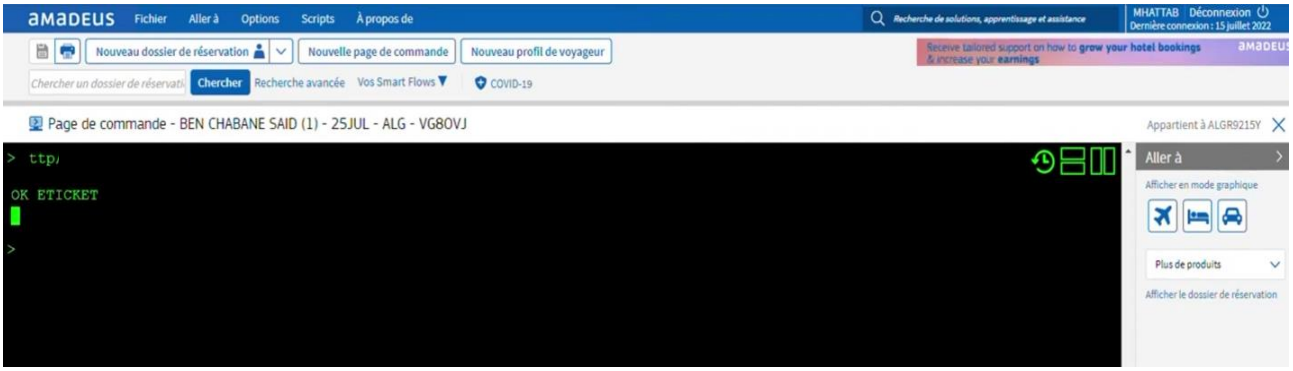


Figure (2, 12): Issue ticket

Decodage:

- GDS sends a message to the airline's ticketing system to:
  - Generate an ETKT number
  - Log ticket to the BSP (Billing and Settlement Plan)
  - Store the ticket with status "Open for Use"

2.11.2 Decodage (Interpreting and Executing the Booking)

Amadeus and the airline systems decode the structured inputs to perform:

Step	Decoder	Function
Flight Search	Amadeus GDS	Query airline availability
Fare Quote	Amadeus Fares Engine	Apply fare rules, taxes, display pricing
PNR Creation	PNR Module	Allocate segments, assign SSRs, generate record locator
Ticketing	Airline Host System	Issue e-ticket, update inventory
Notification	Amadeus + Airline	Send SMS/email confirmation

Table (2, 11): Décodage (Interpreting and Executing the Booking)

2.113 End-to-End Booking Workflow Summary

Phase	Codage (Input)	Décodage (System Action)
1. Search Flights	`AN10SEPALGCDG`	Amadeus checks flight databases
3. Create PNR	`NM1YOUSRA/GHERBI` + `SS1Y1`	System creates PNR, assigns segments
4. Add Services	`SRVGML`, `SRWCHR`	SSRs interpreted and sent to airline systems
5. Ticketing	`FXP`, `TTP`	Fare stored, e-ticket issued, PNR finalized
6. Confirmation	(Email/SMS setup)	Customer receives itinerary

Table (2, 12): End-to-End Booking Workflow Summary

2.11.4 Technologies & Protocols Used

Layer	Technology	Role
Interface Layer	Cryptic (CMDs), GUI, API (REST/XML)	User input
Middleware (GDS)	Amadeus Altea, EDIFACT, XML	Routing, decoding, inventory access
Airline Back-end	PSS (Passenger Service Systems)	Inventory, ticketing, SSRs
Messaging Protocols	IATA EDIFACT, XML, SOAP, REST	Interoperability with partners

Table (2, 13): Technologies & Protocols Used

2.11.5 Roles of Agents, Customers, and the System

- **Travel Agents:**
  Use Amadeus terminals or third-party front-ends powered by Amadeus APIs to search, book, and manage reservations. Agents rely on system tools for itinerary planning and customer service.
- **Customers:**
  Through online travel agencies or airline websites integrated with Amadeus, end-users can perform self-service bookings with instant confirmation.
- **System:**
  Acts as the backend engine, coordinating inventory access, fare calculation, booking validation, and payment processing across multiple providers.

2.12 Comparison with Other Systems34

- **Similar Systems Comparison**

System	Provider	Market Presence & Strengths	Distinguishing Features
Sabre	Sabre Corporation	North America dominance, advanced data analytics	Deep airline integrations, strong loyalty program support
Galileo	Travelport	Wide hotel inventory, strong agent adoption in Europe & Asia	Focus on leisure travel, advanced fare shopping tools
Travelport	Travelport	Global reach through merger with Galileo & Worldspan	Unified multi-GDS platform, strong corporate travel tools
TravelSky	China TravelSky	Leading in Chinese domestic travel	Specialized regional focus, government-aligned services

Table (2, 14): Similar Systems Comparison

- **Key Differences and Advantages**

- Amadeus is renowned for superior European market penetration and cloud infrastructure leadership.
- Sabre offers advanced analytics and customer relationship management tools.
- Travelport emphasizes leisure travel services and multi-GDS integrations.
- TravelSky caters specifically to Chinese domestic and regional travel needs, with limited global reach.

34 Buhalis, D. (2003). eTourism: Information Technology for Strategic Tourism Management. Pearson Education pp. 153–161.

2.13 Conclusion

Chapter 02 expanded on the theoretical groundwork by diving into the architectural and operational framework of Amadeus. It highlighted the core system components, including the Central Reservation System, Inventory Management, and pricing modules, while also examining how the system delivers business value across global markets. Through analysis of financial performance, future trends, and practical booking workflows, the chapter demonstrated how Amadeus functions as a scalable, resilient, and innovative platform.

The insights gained here provide a critical transition into the next phase of this study, which focuses on hands-on interaction with the Amadeus Simulator. This practical component will allow for the application of technical knowledge in real-world booking scenarios using cryptic commands and live system workflows.

Chapter 03:
Application Development and Database Implementation

Chapter 3

Application Development and Database Implementation

3.1 Introduction

This chapter details the technical process of building the Amadeus simulation desktop application. The objective was to develop a standalone training tool that mimics the core functionalities of a commercial airline reservation system.

3.2 Technology Stack

- Language: Python

➢ Python is a high-level, interpreted programming language known for its simplicity and readability. It supports multiple programming paradigms, including procedural, object-oriented, and functional programming. Python is widely used for developing desktop applications, web apps, automation scripts, data analysis, and AI.[35]

- Database: SQLite

➢ SQLite is a lightweight, embedded relational database management system. It stores data in a single file, requires no server setup, and is ideal for desktop and small-to-medium applications. It supports standard SQL queries and is fully ACID-compliant.[36]

- GUI Framework: Tkinter

➢ Tkinter is the standard GUI (Graphical User Interface) toolkit included with Python. It allows developers to create windows, dialogs, buttons, labels, and other graphical elements. Tkinter is built on top of the Tcl/Tk GUI toolkit and is widely used for building lightweight desktop applications.[37]

- Tools Used: VS Code, DB Browser for SQLite

35 Python Software Foundation. What is Python? Retrieved from https://www.python.org/doc/essays/blurb/

36 SQLite Documentation. Retrieved from https://sqlite.org/docs.html

37 Tkinter — Python interface . Retrieved from https://docs.python.org/3/library/tk.html

- Visual Studio Code is a powerful, open-source code editor developed by Microsoft. It supports many programming languages, includes built-in Git support, and has a rich ecosystem of extensions for Python, SQLite, and more.[38]
- DB Browser for SQLite is a visual tool used to create, design, and edit SQLite database files. It allows users to browse tables, run SQL queries, and manage database schemas without writing raw SQL from scratch.[39]

3.3 Data Acquisition

I manually collected flight data from public travel websites and aviation sources. These datasets included airport codes, airlines, flight schedules, and seat configurations.

3.4 Database Design

The database was self-designed and structured using normalized schema to handle:

- Name_of_airport(ID_of_city, code_IATA3L, name_Airport,kind_of_airport)
- save_name(ID_name , expression)
- **AXR_PNR** (ID_AXR, name_PNR, name_sp_PNR, name_pass)
- **Aircraft_Codes** (IATA, Manufacturer, Type_Model, Wake)
- **Fare_PNR** (PNR_Code, Fare)
- **Passport** (ID_Passport, Name_passenger, code_pnr)
- **airline_company**(code_company ,code_iata,code_numbre_Comapny ,name_of_company)
- **available_class**(ID,IDcode_iata_flight_number,IDplace_class)
- **available_flight_day**(ID_flight ,ID_choice ,week_day)
- **choice_of_flight** (ID_choice, code_iata_flight_number , airport_depart , international_domestic, airport_arrival , departure_time , arrival_time , stopover , type_equipment , Fare , taxXR , taxXE , taxXT)
- **city_of_airport**(ID_of_city ,province ,code_iso)
- **country_code** (iso_code, country_code, Country_Name, WHO_Region, Currency_Name, Currency_Code)
- **data_of_flights** (ID_flight, family_name , Name_P , AL , name_class , date_reservation , destination , number_of_places , code_pnr , number_of_ticket , travel_date, travel_date_arrival)
- **destination**(ID_destination,ID_choice ,destination)

38 Microsoft. Visual Studio Code - Code Editing. Redefined. Retrieved from https://code.visualstudio.com/

39 DB Browser for SQLite. Official Website. Retrieved from https://sqlitebrowser.org/

- **name_familyname** (ID ,info_name)
- **place_class**(ID_class ,place_class,price)
- **pnr_with_name** (ID_flight,family_name ,Name_P ,AL ,name_class ,date_reservation ,destination ,number_of_places ,code_pnr ,number_of_ticket ,travel_date)
- **reservation** (ID_res,flight_iata ,name_class ,date_res ,number_dayoftheweek ,destination ,confirmed ,Depart_time ,arrival_time ,Equipment_code ,Electronic_ticketing ,Number_of_stops ,Fare ,taxXT ,taxXE ,taxXR ,number_flight ,status_coupon ,international_domestic)

3.5Application Architecture

The application follows a modular design:

- GUI Login Interface: Developed using Tkinter to enhance the program's security by restricting access to authorized users only.

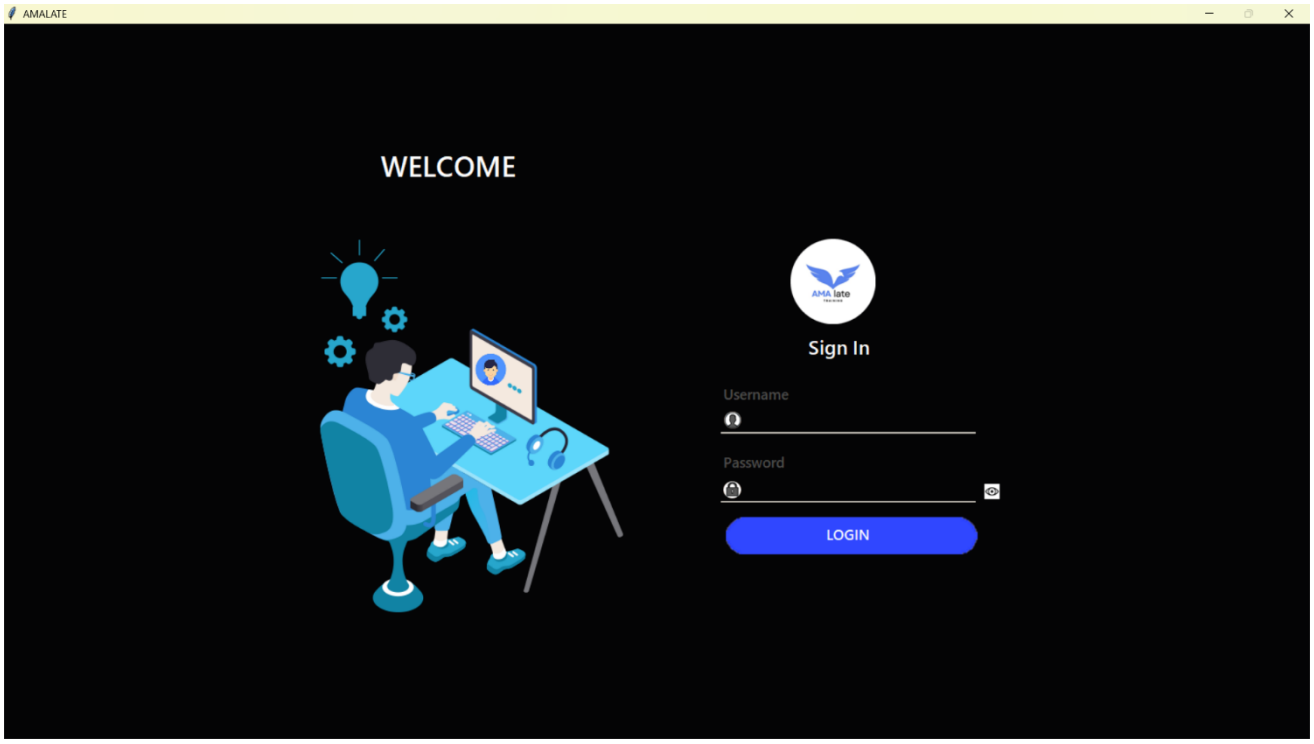


Figure (3, 1): GUI Login Interface

- Command Console: A custom-built console that allows users to search for flights, enter passenger details, and confirm bookings through direct command input.

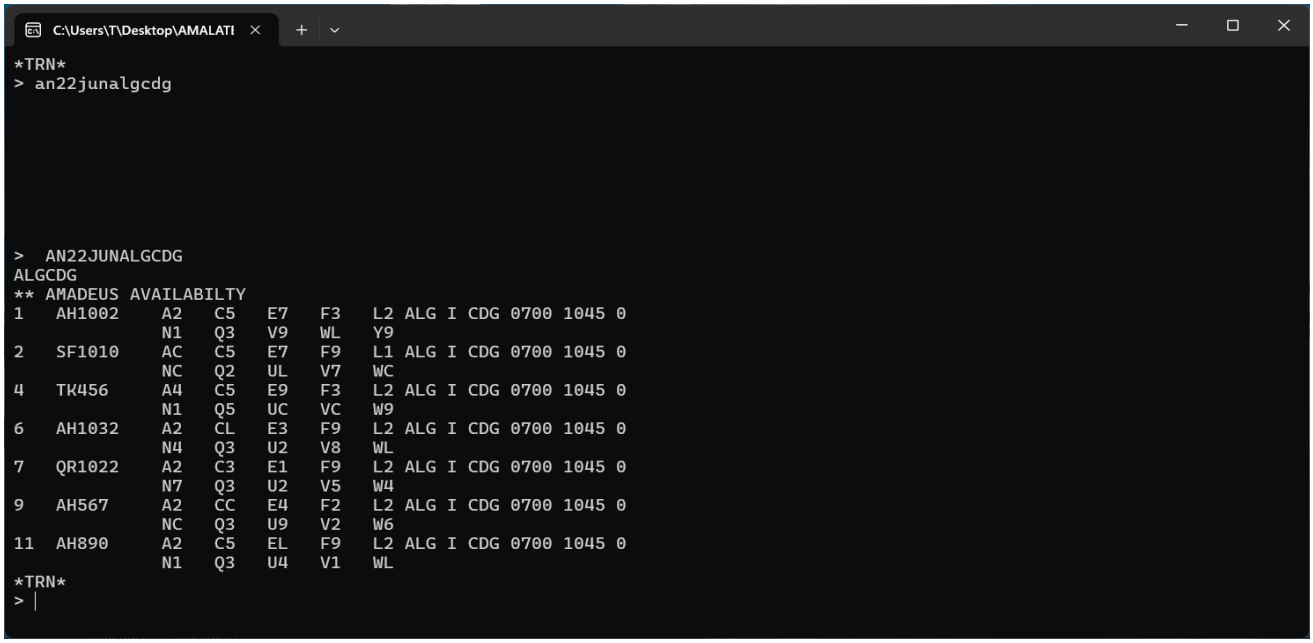


Figure (3, 2): Command Console

- Logic Layer: Processes user inputs, performs validations, and manages booking-related operations.
- Data Layer: Connects with an SQLite database, executes SQL queries, and handles CRUD (Create, Read, Update, Delete) operations.

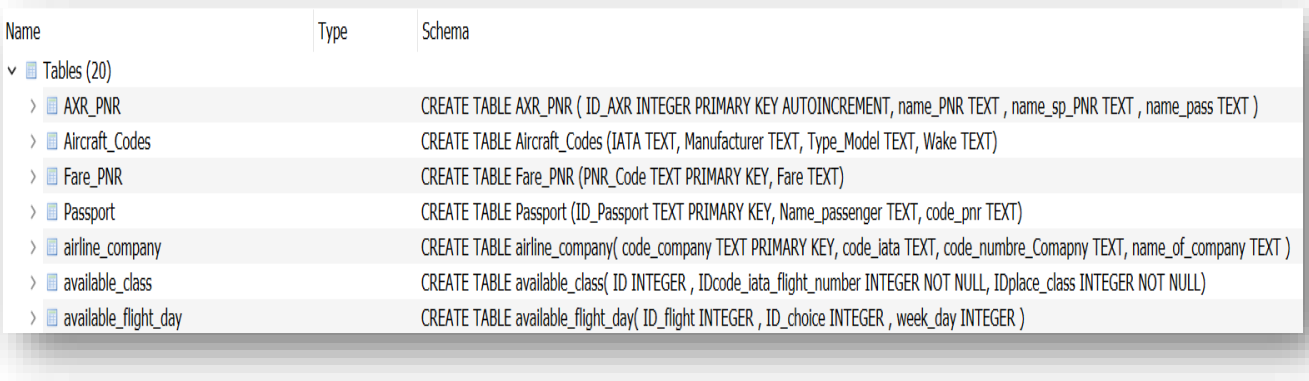


Figure (3, 3): Database show some table in database

3.6 Development Workflow

1. Designed and built SQLite database schema.
2. Created basic GUI login interface and Command Console for booking interface.
3. Integrated flight search, seat allocation, and PNR generation logic.
4. Tested each module independently.

5. Linked modules for full application flow.

3.7 Core Functionalities Implemented

- Flight Search based on origin, destination, and date.
- Passenger Data Entry with validation.
- Seat Selection from available seats.
- Booking Confirmation with PNR and summary.

➢ Sample Code Snippet

```
# execute your query
  cursor.execute(''' SELECT choice_of_flight.ID_choice ,code_iata_flight_number , GROUP_CONCAT(DISTINCT place_class.place_class )
    AS place_class , airport_depart , airport_arrival , departure_time , arrival_time , stopover ,
    type_equipment , international_domestic
    from choice_of_flight
    INNER JOIN available_class
    ON choice_of_flight.ID_choice = available_class.IDcode_iata_flight_number
    INNER JOIN place_class
    ON available_class.IDplace_class= place_class.ID_class
    INNER JOIN available_flight_day
    ON choice_of_flight.ID_choice = available_flight_day.ID_choice
    INNER JOIN destination
    ON choice_of_flight.ID_choice = destination.ID_choice
    WHERE destination.destination ='{0}' and available_flight_day.week_day = {1}
    group by choice_of_flight.ID_choice ; '''.format(complet_action,num_week))
  # fetch all the matching rows
  result = cursor.fetchall()
```

Figure (3, 4): Sample Code Snippet

This function queries the database for matching flights.

3.8 Conclusion

The development of the Amadeus Simulation Application represents a practical and educational milestone in replicating core airline reservation processes within a desktop environment. This chapter detailed the end-to-end development workflow—from data acquisition and database design to GUI implementation and functional integration—using Python, SQLite, and Tkint

Chapter 04:
User Guide: Booking a Flight through the AMALATE

Chapter 4

User Guide: Booking a Flight through the AMALATE

4.1 Introduction

This chapter provides a step-by-step demonstration of how the developed desktop application simulates a real-world flight reservation system. The goal is to illustrate the core features, user interactions, and backend processes involved in searching for flights, entering passenger details, pricing, and issuing tickets. By walking through a realistic booking scenario, this chapter highlights how the graphical user interface (GUI), command inputs, and database operations work together to mimic the Amadeus reservation workflow. Each stage is supported by screenshots and code execution outputs to provide a clear understanding of the system's functionality.

4.2 Example: Using the Application to Reserve a Ticket

To demonstrate how the desktop simulation works in practice, consider the following use case:

- **Step-by-Step User Scenario**

1. **User Opens the Application**
    - The First screen displays login, enter Username and Password.

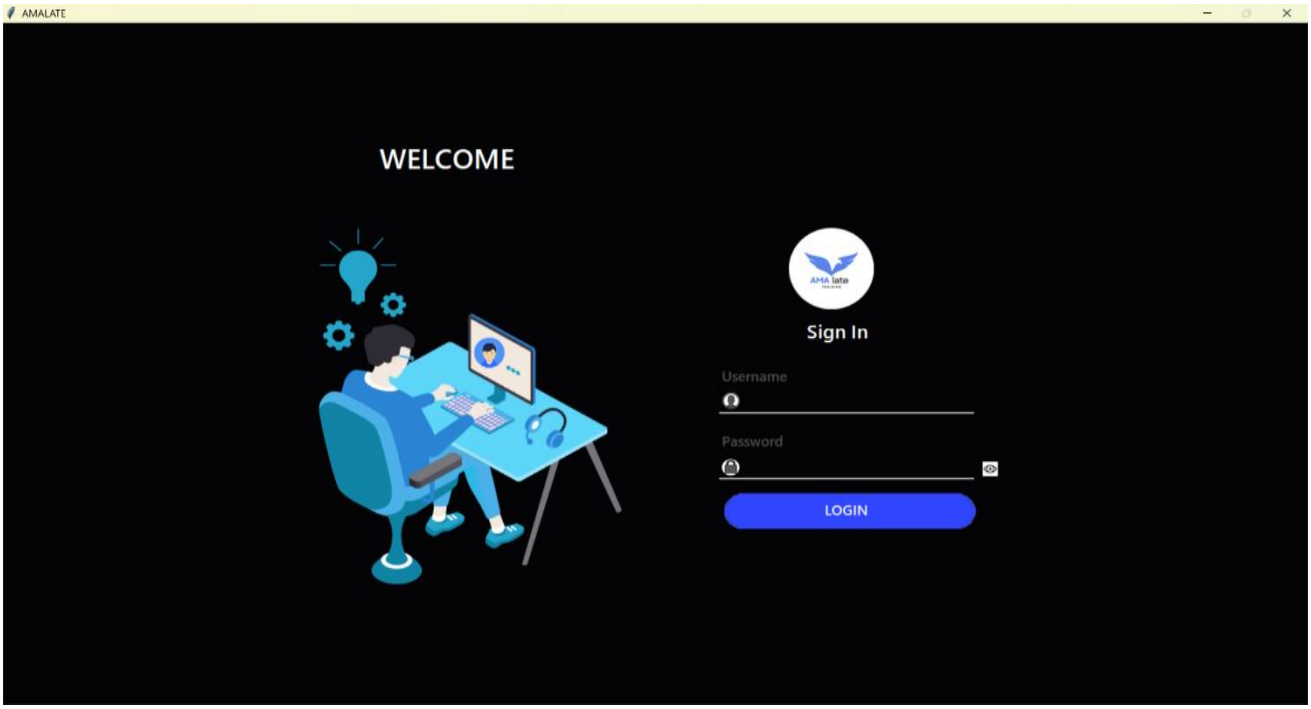


Figure (4, 1): GUI Login Interface

2. **Flight Search**
    - The user choice and enter AN22JUNALGCDG
        - Origin: ALG (Algiers)
        - Destination: CDG (Paris Charles de Gaulle)
        - Date: 2025-06-22
    - The system executes:

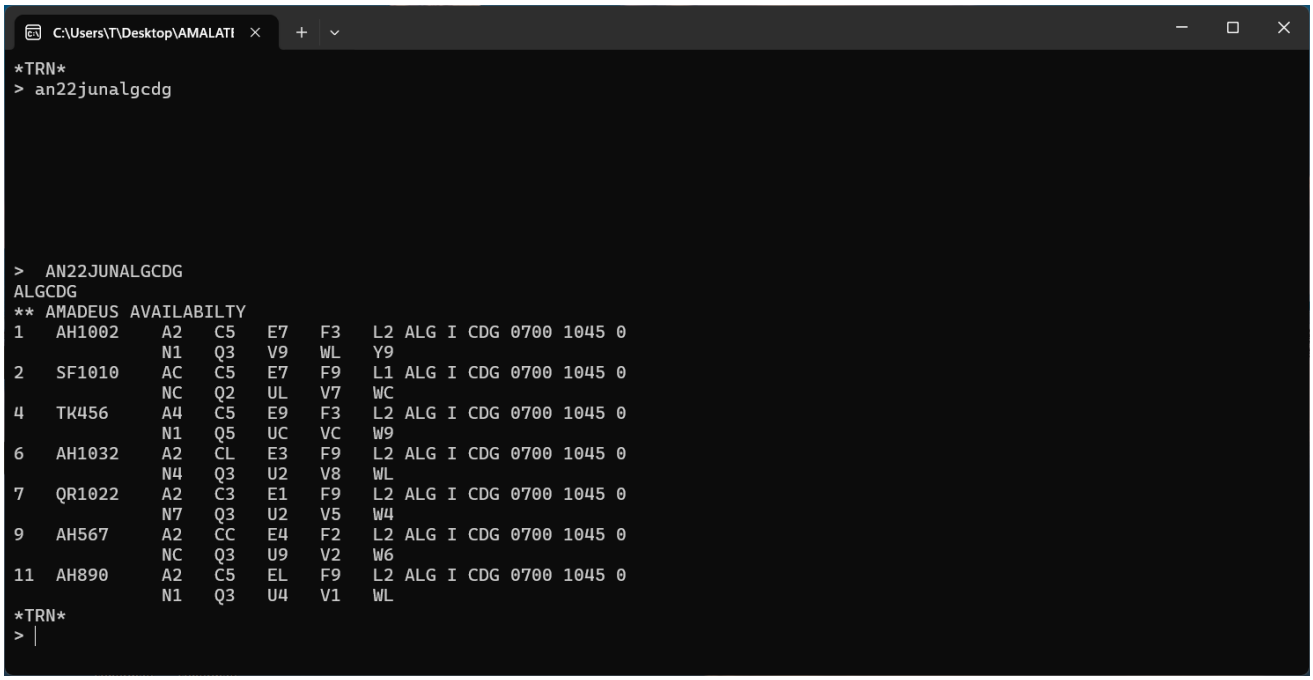


Figure (4, 2): System show availability flight

    - Matching flights are displayed in a list with flight numbers and departure times.

3. **Select a Flight and Choose a Seat**
    - The user choice the Flight TK456 and select a seat A, which departs at 10:45 by entering SS1A4

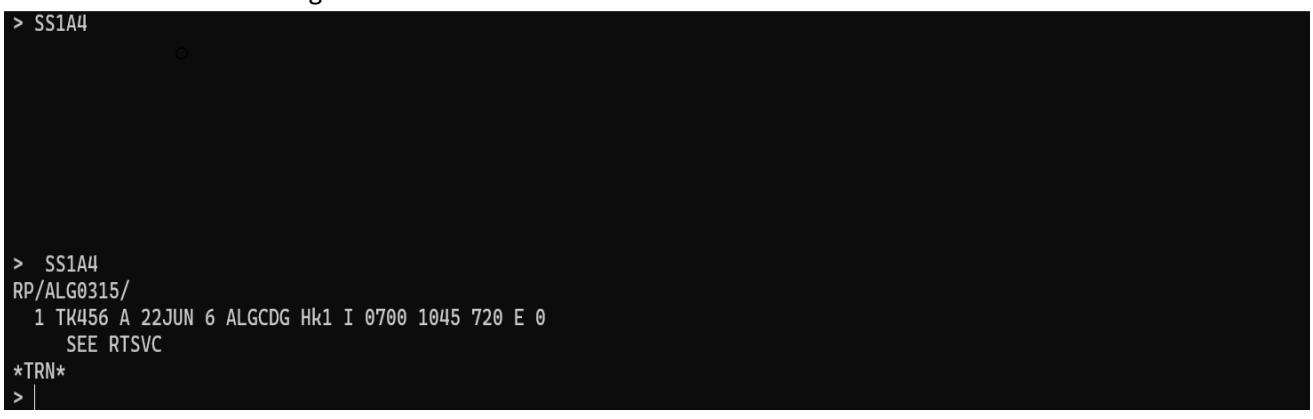


Figure (4, 3): Select seat in the flight

4. **Enter Passenger Information**

   - The user fills out by NM1GHERBI/YOUSRA:

```
> NM1GHERBI/YOUSRA




>  NM1GHERBI/YOUSRA
RP/ELU0315/
1 GHERBI/YOUSRA
2 TK456 A 22JUN 6 ALGCDG HK1 I 0700 1045 720 E 0
*TRN*
>
```

Figure (4, 4): Passenger Information

5. **Confirm Booking**

   - The system creates a booking record and generates a PNR after enter AP and TKOK with signature RFCY :

```
> AP




>  AP
RP/ELU0315/
1 GHERBI/YOUSRA
2 TK456 A 22JUN 6 ALGCDG HK1 I 0700 1045 720 E 0
3 AP ELU 213656151850 - AMALATE TRAVEL -
*TRN*
>
```

Figure (4, 5): AP commend

```
> TKOK




>  TKOK
RP/ELU0315/ELU0315         FP/SU 10JUN25/2127  BVTX15
1 GHERBI/YOUSRA
2 TK456 A 22JUN 6 ALGCDG HK1 I 0700 1045 720 E 0
3 AP ELU 213656151850 - AMALATE TRAVEL -
4 TK OK 12JUN/ELU0315
*TRN*
>
```

Figure (4, 6): TKOK commend

```
> RFCY




>  RFCY
RP/ELU0315/
RF GY
1 GHERBI/YOUSRA
2 TK456 A 22JUN 6 ALGCDG HK1 I 0700 1045 720 E 0
3 AP ELU 213656151850 - AMALATE TRAVEL -
4 TK OK 12JUN/ELU0315
*TRN*
>
```

Figure (4, 7): Signature RFCY

- The reservation is stored in the database, linking flight, passenger, seat, and PNR: BVTX15.

6. **Ticket Pricing**

- The user use command-line entries to price a booked itinerary, the command used is (FXP)

```
> FXP




>  FXP
FXP
GHERBI/YOUSRA*
LAST TKT 10JUN25 - SEE ADV PURCHASE
------------------------------------------------------------
      AL FLGT BK T DATE TIME FARE BASIS        NVB  NVA  BG
ALG
CDG   TK 456  A A 22JUN 0700 AG3JALF              11JUN 30
DZD    25684.0   22JUN25ALG TK CDG64.49TK ALG64.49NUC128.98
                 END ROE77.522240
DZD    6600YR    XT DZD 20DZ DZD 1500DZ DZD 1150QX DZD 491
DZD     900XE    IZ DZD 854XE DZD 1169XE
DZD    5184XT
DZD  25684.00
DZD  25684.00 TOTAL INCL DZD 0 AGENT TKT FEE
FEE PARTIALLY BASED ON VC=TK AND TT=ET
BG CXR: TK/TK
TICKETS ARE NON-REFUNDABLE
*TRN*
>
```

Figure (4, 8): Ticket Pricing FXP

- Amadeus evaluates the fare and provides:

  - The total ticket cost (including taxes and surcharges)
  - The fare basis code
  - Rules and restrictions of the fare
  - Applicable ticketing deadlines

- Signature of the client accept the price :

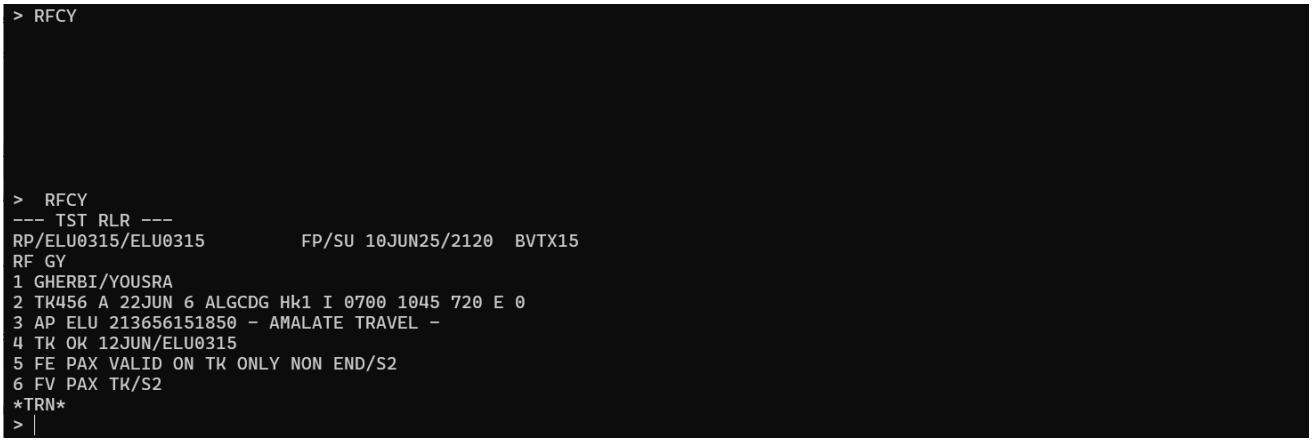


Figure (4, 9): Signature RFCY accepted the price

7. Ticket Payment Using FP (Form of Payment)

The *FP* command informs the system how the customer intends to pay for the ticket.

Common Examples of FP Commands:

- FP CASH → Payment by cash
- FP CCVI4111111111111111/1225 → Credit card (Visa) with expiration 12/25
- FP CHECK → Payment by check
- FP INV → Payment by invoice (corporate clients)

After the seat is selected and the fare is calculated, a payment method dropdown or field can simulate this step. It may allow users to choose between:

- Cash
- Credit Card
- Check

Based on the selection, the system stores the payment type in the database and flags the reservation as “ready for ticketing”.

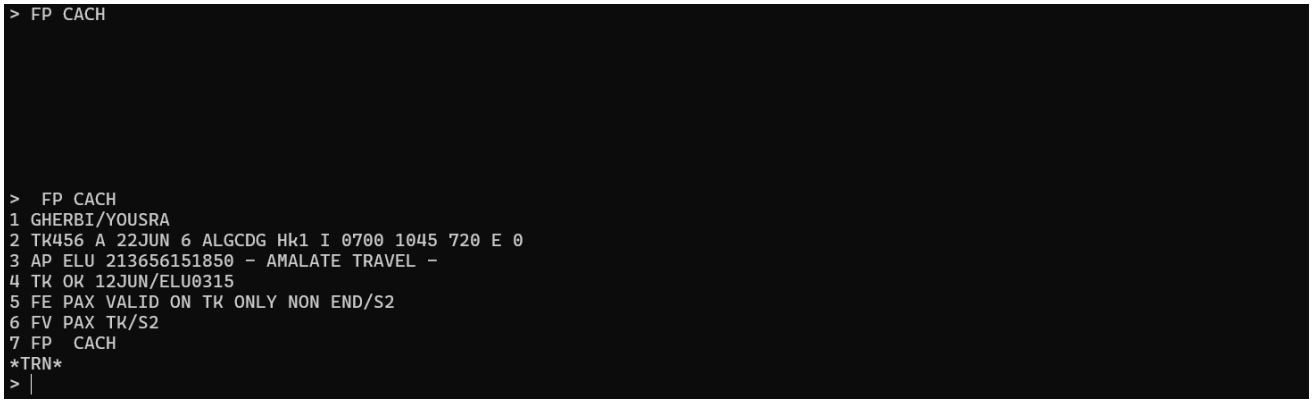


Figure (4, 10): Type Payment

8. **Ticket Issuance and Printing (TTP Command)**

   Once the PNR is created, priced, and the form of payment (FP) is entered, the final step before completing the reservation is issuing the ticket. This is done using the (TTP)

Figure (4, 11): Print Ticket

4.3

AMA late
TRAINING

Issuing office:
GH EL OUED CTO,CITE 460 LOGTS
EL OUED, EL OUED ,
Telephone: 0656151850

Date: 10JUN25

Passenger: GHERBI/YOUSRA (ADT)

Booking ref: BVTX15

Ticket number: 235-2913804758

FOID:

ELECTRONIC TICKET RECEIPT

ELECTRONIC TICKET RECEIPT

At check-in, you must provide valid travel documents. Check-in opens 03 hours before departure of flight.

From	To	Flight	Departure	Arrival	Last check-in
Aéroport d'Alger - Houari Boumédiène Terminal:I	Charles de Gaulle International Airport	TK456	0700 22JUN2025	1045 22JUN2025	0600
Class: A Baggage (4): 30K Fare basis:SRTTK	Operated by:T Marketed by: T Booking status (1): OK			NVB (2): 22JUN2025 NVA (3): 22JUN2025 Duration: 0345	

(1) OK = confirmed (2) NVB = Not valid before (3) NVA = Not valid after (4) Baggage: K = Kilo, PC=Piece. You may check-in the weight/ number of baggage items listed above free of charge. Beyond this limit, you must pay an extra fee.

PAYMENT DETAILS

Fare Calculation: Fare Calculation :ALG TK CDG25684.0NUC25684.0

Form of payment: CACH
Endorsements: TURKISH AIRLINES ONLY

FARE DETAILS

Fare:	25684.0
Taxes:	DZD 5184XE DZD 6600TR DZD 900YR
Total Amount:	25684.0

Figure (4, 12): ELECTRONIC Ticket

4.4 Future Enhancement

This desktop app is the first phase. A future phase will include building a web version using Django or Flask, with cloud database integration, real-time flight updates, and user authentication.

4.5 Conclusion

The systematic simulation presented in this chapter demonstrates how the desktop application replicates the core stages of flight booking in a travel reservation system. From login to seat selection, fare calculation, payment, and ticket issuance, each function mirrors real-world airline reservation procedures in a simplified, user-friendly environment. This example showcases not only the technical capabilities of the application but also its value as an educational and prototyping tool for understanding airline-booking systems. The integration of Python, SQLite, and Tkinter proves effective in delivering a modular, interactive, and scalable desktop application.

Looking forward, the project sets the stage for future enhancements, such as developing a web-based version with real-time features and cloud integration. These improvements will expand accessibility and functionality, making the simulation tool even more aligned with modern airline IT systems.

General Conclusion

General Conclusion

This project has provided a comprehensive exploration of the Amadeus Booking Platform, combining in-depth theoretical analysis, architectural understanding, and hands-on application development. Through a structured three-chapter progression, the study has bridged the gap between academic knowledge and practical implementation in the field of travel technology.

Chapter 01 laid the foundation by tracing the evolution of airline booking systems and highlighting Amadeus's emergence as a global travel technology leader. It explored the historical context, system functionality, and competitive advantages that have positioned Amadeus as a dominant Global Distribution System (GDS) within the travel and tourism sector.

Chapter 02 extended this foundation by examining the core architecture of the platform, including its Central Reservation System (CRS), Inventory Management System (IMS), and Fare and Pricing Modules. It also discussed Amadeus's business impact, global market reach, and financial resilience—particularly in response to the challenges of the COVID-19 pandemic. Furthermore, the chapter showcased Amadeus's commitment to digital innovation through AI integration, sustainability efforts, and strategic partnerships.

Chapter 03 transitioned from analysis to application, detailing the development of a simulation tool designed to replicate Amadeus functionalities in a desktop environment. This practical module allowed for the demonstration of real-world booking processes such as flight search, PNR creation, fare calculation, and ticket issuance. The project exemplified how academic research can be translated into a working prototype, offering valuable insights for students, educators, and future travel tech developers.

Together, these chapters underscore the strategic importance of GDS platforms like Amadeus in shaping the future of digital travel. By combining conceptual depth with technical execution, this work contributes meaningfully to both academic research and applied training in the domain of airline reservation systems.

References

BIBLIOGRAPHY:

1. Copeland, D. G., & McKenney, J. L. (1988). Airline reservation systems: Lessons from history. MIS Quarterly, 12(3).
2. Buhalis, D. (2003). eTourism: Information Technology for Strategic Tourism Management. Pearson Education.
3. Law, R., Leung, R., & Buhalis, D. (2009). Progress in information technology and tourism management: 20 years on and 10 years after the Internet. Tourism Management, 29(4).
4. Amadeus IT Group. (2021). Technology and innovation in travel: Trends shaping the future. Retrieved from https://amadeus.com
5. Sheldon, P. J. (1997). Tourism Information Technology. CAB International.
6. Buhalis, D., & Law, R. (2008). Progress in information technology and tourism management: 20 years on and 10 years after the Internet. Tourism Management, 29(4).
7. Amadeus IT Group. (2021). Amadeus Company History and Milestones. Retrieved from https://amadeus.com
8. Amadeus IT Group. (2023). Company milestones and innovation timeline. Retrieved from https://amadeus.com/en/about/our-company/our-history
9. Amadeus IT Group. (2022). Technology for smarter travel: API solutions and digital innovation. Retrieved from https://amadeus.com
10. Amadeus IT Group. (2023). A trusted technology partner to the travel industry. Retrieved from https://amadeus.com/en/industries/airlines
11. Amadeus IT Group. (2023). The future of travel: Personalization, sustainability, and smart connectivity. Retrieved from https://amadeus.com
12. Amadeus for Developers. (2023). Amadeus API documentation and architecture overview. Retrieved from https://developers.amadeus.com
13. Amadeus for Developers. (2023). Build travel applications with Amadeus APIs. Retrieved from https://developers.amadeus.com
14. Sheldon, P. J. (1997). Tourism Information Technology. Wallingford, UK: CABI Publishing.
15. Amadeus IT Group. (2023). Powering the travel ecosystem: Solutions for airlines, travel agencies, and online platforms. Retrieved from https://amadeus.com
16. Amadeus IT Group. (2023). Amadeus airline IT solutions: Supporting global operations. Retrieved from https://amadeus.com/en/industries/airlines
17. Amadeus IT Group. (2022). How Amadeus empowers travel agencies and corporate travel platforms. Retrieved from https://amadeus.com
18. Amadeus IT Group. (2023). Travel technology solutions for airlines, agencies, and online platforms. Retrieved from https://amadeus.com
19. Amadeus IT Group. (2023). Open architecture and system integration for global travel platforms. Retrieved from https://amadeus.com

20. Sheldon, P. J. (1997). Tourism Information Technology. CABI Publishing pp. 59–78.

21. Amadeus IT Group. (2023). System architecture and reservation platform overview. Retrieved from https://developers.amadeus.com
22. Amadeus IT Group. (2023). Airline inventory management and distribution solutions. Retrieved from https://amadeus.com
23. Amadeus IT Group. (2023). Airline pricing, fares, and revenue optimization solutions. Retrieved from https://amadeus.com
24. Amadeus IT Group. (2023). Amadeus system architecture: Component integration and platform overview. Retrieved from https://developers.amadeus.com
25. Amadeus IT Group. (2023). Flight booking and seat management solutions. Retrieved from https://amadeus.com
26. Amadeus IT Group. (2023). Airline IT solutions: Optimization, Altéa Suite, and analytics platforms. Retrieved from https://amadeus.com
27. Amadeus IT Group. (2023). Airline IT solutions: Optimization, Altéa Suite, and analytics platforms. Retrieved from https://amadeus.com
28. Amadeus IT Group. (2023). Annual report and financial highlights 2023: Business strategy and economic impact. Retrieved from https://amadeus.com

29. Amadeus IT Group. (2023). Annual Report 2022–2023: Financial performance and strategic overview. Retrieved from https://amadeus.com
30. Amadeus IT Group. (2023). Sustainability and investment report: Strategic growth and global economic impact. Retrieved from https://amadeus.com
31. Amadeus Learning Universe. (2023). Course catalog: GDS and Altéa training programs for travel professionals. Retrieved from https://learning.amadeus.com
32. Amadeus IT Group. (2023). Corporate capabilities: Technology, training, partnerships, and sustainability. Retrieved from https://amadeus.com
33. Amadeus for Developers. (2023). Airline booking workflow and API documentation. Retrieved from https://developers.amadeus.com

34. Buhalis, D. (2003). eTourism: Information Technology for Strategic Tourism Management. Pearson Education
35. Python Software Foundation. *What is Python?* Retrieved from https://www.python.org/doc/essays/blurb/
36. *SQLite Documentation*. Retrieved from https://sqlite.org/docs.html
37. *Tkinter — Python interface* . Retrieved from https://docs.python.org/3/library/tk.html
38. Microsoft. *Visual Studio Code - Code Editing. Redefined.* Retrieved from https://code.visualstudio.com/
39. DB Browser for SQLite. *Official Website*. Retrieved from https://sqlitebrowser.org/

OUTBUILDING

Feasibility Study for Amadeus Simulation System

1. Technical Feasibility

1.1 **Development Tools & Technologies**

- Programming Language: Python
- GUI Framework: Tkinter
- Database: SQLite
- Backend Logic: Custom Python modules

1.2 **System Requirements**

- Minimum: Dual-core CPU, 4GB RAM, 1GB storage
- Recommended: Quad-core CPU, 8GB RAM, SSD

1.3 **Architecture Design**

- Modular structure: Flight search, booking, seat selection, ticketing
- Expandable to web version using Django or Flask

1.4 **Conclusion**

- Technically feasible with available open-source tools and basic hardware.

2. Economic Feasibility

2.1 **Cost Breakdown**

- Software Tools: Free
- Hardware: Existing university computers
- Development: By student, no labor cost
- Deployment: Free for desktop version

2.2 **Estimated Future Costs (for web version)**

- Hosting: 14000 DZD–30000 DZD/year
- Domain: 2600 DZD –5000 DZD /year
- Maintenance: Low (estimated 10–20 hours/month)

2.3 **Benefits**

- Saves on real GDS license fees
- Reduces training costs
- Scalable for academic institutions

2.4 **Conclusion**

- Economically feasible and cost-efficient.

3. Operational Feasibility

3.1 **Target Users**

- University students (IT / Airline tech)
- Travel agency interns
- Academic trainers

3.2 **Core Features**

- Simulated ARS functions:
  - Flight search
  - Seat availability
  - PNR creation
  - Booking and ticketing

3.3 **Training Value**

- Simulates real ARS logic
- Prepares users for working with actual systems

3.4 **User Experience**

- Simple and intuitive interface
- Customizable for different training scenarios

3.5 **Conclusion**

- Strongly meets training and operational goals.

4. Legal & Ethical Feasibility

4.1 **Legal Compliance**

- Original codebase
- No copying of proprietary Amadeus software
- Only open-source tools used

4.2 **Data Ethics**

- No real customer data used
- Dummy flight and user data
- Compliant with privacy norms

4.3 **Conclusion**

- Legally and ethically safe for academic use.

5. Schedule Feasibility

5.1 **Estimated Timeline**

Phase	Duration
Requirement Analysis	1–2 weeks
System Design	1 week
Development (Coding)	6–8 weeks
Testing & Debugging	2 weeks
Documentation & Guide	1–2 weeks
Presentation Preparation	1 week
Total	**12–16 weeks (3–4 months)**

5.2 **Risks & Mitigations**

- Delay in coding ➤ Use modular design, test early
- Limited access to real system ➤ Use realistic simulation with public documentation

5.3 **Conclusion**

- Project timeline is achievable for a Master's program.

Financial Feasibility for Amadeus Simulation Program

1. Initial Development Costs (Desktop Version)

Item	Estimated Cost (USD)	Notes
Development Tools (Python, IDEs)	0 DZD	Free and open-source (e.g., VS Code)
Database (SQLite)	0 DZD	Open-source
GUI Library (Tkinter)	0 DZD	Included in Python or free version
Internet and Utilities	2320 DZD /month	Required for research and testing
Total	**2320 DZD (monthly cost only)**	No major investment for initial build

2. Future Upgrade Costs (Web Version)

Item	Estimated Cost (USD/year)	Notes
Web Hosting	14000 DZD–30000 DZD	Shared or VPS hosting
Domain Registration	2600 DZD –5000 DZD	For website name
SSL Certificate	0 DZD – 15000 DZD	Free with some hosts, or paid
Backend Framework (Django/Flask)	0 DZD	Free and open-source
Frontend Tools (Bootstrap, JS)	0 DZD	Open-source
Total	**14000 DZD –50000/year**	Optional based on project goals

3.Maintenance & Support

Item	Estimated Cost (USD/year)	Notes
Bug Fixes & Updates	50000 DZD	No cost if self-maintained
System Backup & Monitoring	10000 DZD	Free tools or optional upgrades
Total	**60000 DZD/year**	Based on level of support needed

3. Training & User Support

Item	Estimated Cost (USD)	Notes
User Manual & Guide Creation	500DZD	DIY or printed materials
Trainer by level	30000 DZD	Free if done by student/instructor

4. Benefits / Return on Investment (ROI)

Benefit	Estimated Value (USD)
Cost Savings vs Real Amadeus Licenses	50000DZD-150000 DZD
Student Training (simulation instead of real ARS)	Priceless (Educational value)
Reusability for future sessions	High
Scalability (multi-institute use)	Excellent

Conclusion

- **Total Initial Cost** (Desktop): **9280 DZD**
- **Benefits & ROI**: Huge value in training, saves tens of thousands in license costs, scalable and reusable.
- **Feasibility**: **Highly financially feasible**, especially for academic or institutional use.

AMA late
TRAINING

Amalate Guide

Product Presentation

Your Ultimate Local Adventure Awaits.

Read More

www.amalate.odoo.com

Introduction

Overview of our simulation amadeus

Welcome to the Amadeus Simulation Program!
This guide will help you understand how to use the desktop application developed to simulate the Amadeus Airline Reservation System. Whether you're a new user or a training participant, this guide walks you through all features step-by-step.

System Requirements

AMA late TRAINING

Before running the application, make sure your computer meets the following:

Operating System: Windows 10/11 or Linux
Python version: 3.10 or above
Installed Libraries: Tkinter (for GUI), SQLite3, reportlab (for ticket PDF)
Disk space: At least 100 MB
RAM: 2 GB minimum

How to Install

Step by Step to install it

First step : Extract WinRAR.
Second Step : Launch amalate.exe and enjoy.

Application Overview

Login

Flight Search

Reservation

Ticket Generator

Access system as user

Look up available flights

Choose seat and book flight

Download a booking ticket as PDF

Using the Application (Step-by-Step)

A. Login or Register

On launch,

Fill in the form with username and password

Click button login

B. Search for Flights

Navigate to Search Flights Enter:

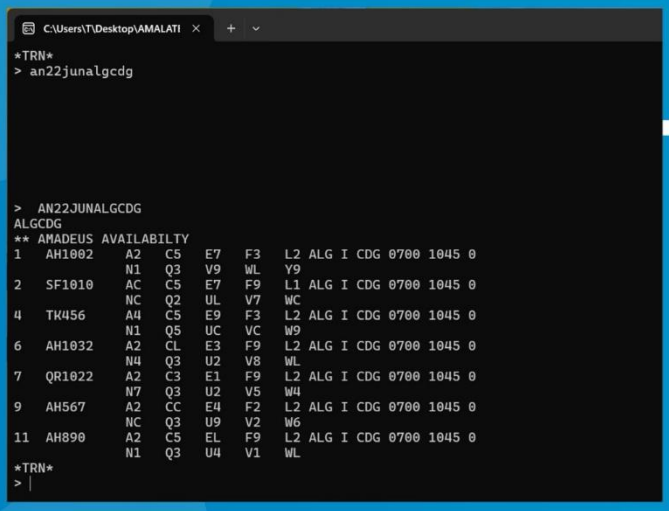
Origin

Destination

Date

Click

A list of flights matching your criteria will appear



C. Make a Reservation

Search for Flight Availability

Choose an available seat from dropdown or seat map

Sell a Flight

Enter Passenger Name

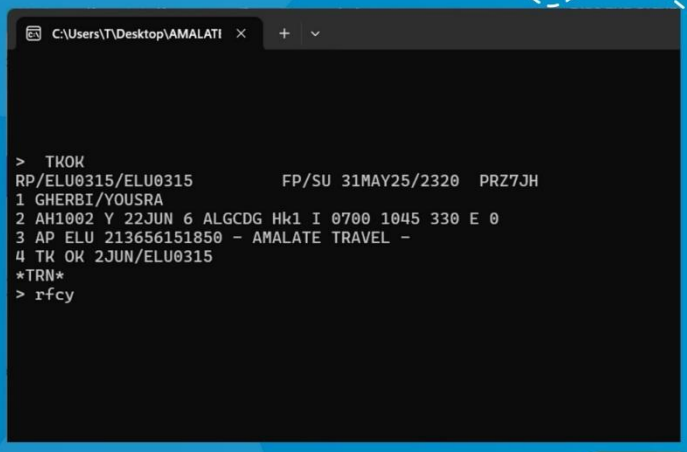
Enter Contact Information

Enter Ticketing Arrangement

Add Received Field (Agent's Name)

End Transaction and Save PNR

The system confirms your reservation and gives you a booking reference number (PNR)

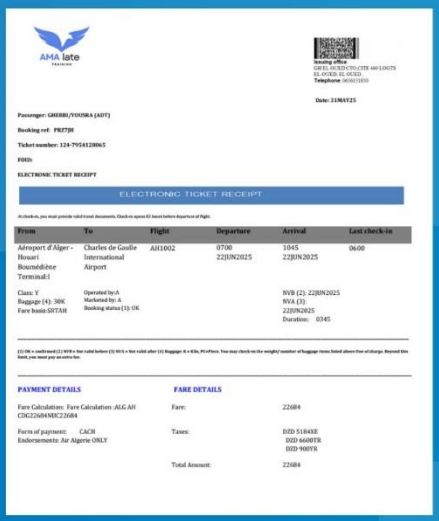


D. CONFIRM AND Download Ticket

```
>  RFCY
1 GHERBI/YOUSRA
2 AH1002 Y 22JUN 6 ALGCDG Hk1 I 0700 1045 330 E 0
3 AP ELU 213656151850 - AMALATE TRAVEL -
4 TK OK 2JUN/ELU0315//ETAH//ETAH
5 FE PAX VALID ON AH ONLY NON END/S2
6 FV PAX AH/S2
7 FP CACH
8 FA PAX 124-7954128065/ETAH/DZD10000/31MAY25/CYGHR0315/15031508/S2
9 FB PAX 4 TTP OK ETICKET/S2
*TRN*
>
```

- After booking, enter TTP for Generate Ticket
- A PDF will be saved to your device showing:
  - Flight details
  - Passenger name
  - Booking code
-

Electronic ticket



AMA late

Date: 31MAY25

Passenger: GHERBI/YOUSRA (ADT)

Booking ref: PRZTJH

Ticket number: 124-7954128065

FOID:

ELECTRONIC TICKET RECEIPT

ELECTRONIC TICKET RECEIPT

From	To	Flight	Departure	Arrival	Last check-in
Aéroport d'Alger - Houari Boumédiène Terminal 1	Charles de Gaulle International Airport	AH1002	0700 22JUN2025	1045 22JUN2025	0600

Class: Y
Baggage (4): 30K
Fare basis/SITAH

Operated by:A
Marketed by: A
Booking status (1): OK

NVB (2): 22JUN2025
NVA (3): 22JUN2025
Duration: 0345

PAYMENT DETAILS

Fare Calculation: Fare Calculation :ALG AH CDG226B4MXC226B4

Form of payment: CACH
Endorsements: Air Algerie ONLY

FARE DETAILS

Fare:	226B4
Taxes:	DZD 5184XE DZD 6600TR DZD 900YR
Total Amount:	226B4

Electronic ticket

The PDF file is created with:

- Passenger info
- Flight info
- Seat and Booking Code

Thank you for being with us

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More Information

+213-0656151850
www.amalate.odoo.com
amalate.training@gmail.com

Amadeus Simulation

Designed By: **Yousra Gherbi**

Key Resources

Simulation software and database
Skilled developers and engineers
Amadeus system API
Cloud servers for deployment

Key Activities

Designing and developing the simulation model
Integrating real-world airline booking data
Testing system functionalities (seat allocation, ticketing, pricing)

Channels

Direct collaborations with airline companies
travel agencies
National Institute
University portals and e-learning platforms
Online websites and research platforms

Revenue Streams

University subscriptions for educational use
Airline companies using the simulation for training
Licensing to travel agencies for internal use
Consulting services for system optimization

Cost Structure

Software development costs
Cloud hosting and data storage expenses
Research and testing resources
Training and documentation creation

Customer Segments

airlines
travel agencies
training centers
aviation training centers

Customer Relationships

dedicated support
consulting
online training
regular updates

Value Propositions

Provides a realistic simulation of airline booking systems
Helps students and researchers understand how Amadeus works
Allows airlines and agencies to test booking strategies without real transactions
Identifies system weaknesses and optimizes performance

Key Partnerships

Airlines and travel agencies (for data simulation)
Universities and research institutions (academic support)
Software developers and IT specialists (for simulation development)