Did you know that Amadeus cumulative investment in R&D since 2004 exceeds 2.9 billion euro?
Research, development and innovation

As a thought leader in the industry it is important to demonstrate that we take responsibility for providing a framework for debate and discussions.

Hervé Couturier - Executive Vice President
Research and Development Amadeus IT Group
Research & Development (R&D) is a key strategic priority for Amadeus; we consider innovation as one of our key assets that will lead us to achieve market leadership.

Amadeus R&D is the part of the organisation that has the responsibility of building innovative solutions for our customers. These solutions are based on a wide range of core products and components which are integrated for the specific needs of customers.

Amadeus R&D puts a special emphasis on the reliability of its systems, products and services. This is a permanent objective as R&D teams conceive, design, develop and maintain some of the world’s most complex, widely available, real-time information systems accessed daily by hundreds of thousands of travel professionals and end-users in almost all areas of the travel industry.

This investment is supported by a network of 17 R&D centres distributed around the world. Nice is Amadeus largest site for activities, with on-site and worldwide teams developing solutions for travel distribution, e-commerce, travel agency points-of-sale, airlines, hotels, railways companies, airport IT and travel intelligence.

This R&D global network organisation is distributed regionally along a model of hubs with a global mission and transversal activities, and satellites which are either dedicated to specific applications or domain expertise, or for some, dedicated to supporting customer projects. All sites work closely with others, and teams working on a project can be distributed between sites. Under the improvement programme, Amadeus R&D deploys common methodology for software programming, quality assurance and more generally for all phases of the
product development cycle. A transversal division was created in January 2013 to support, via competence-driven governance rules and communities, cross-fertilisation between sites in the domains of architecture, software engineering, project management, tools, and common best practices.

Our global networked organisation includes the central R&D centres of Bangalore, Boston and Nice; the R&D sites of Aachen, Antwerp, Frankfurt, Istanbul, London, Madrid, Miami, Strasbourg, Sydney, Toronto and Tucson as well as regional centres in Bangkok, Bogota and Warsaw.

After the successful launch of our R&D centre in Bangalore in 2012, Amadeus has continued growing the scope of its activities and responsibilities, as well as increasing staff. A similar strategy was put in place for the Boston, London, and Sydney centres.

Recruitment is oriented toward incorporating a wide range of expertise and international culture to developing global products. Staff mobility, short or long term, is encouraged. Amadeus also offers numerous internships to top international schools, with a formal recognition of their contribution (we organise a yearly context between interns).

Amadeus pays particular attention to providing staff with stimulating environments that enhance creativity and help spark innovative ideas. In 2013, Amadeus engaged in the redesign of office space to reflect our core values and promote staff interaction.

We also promote a culture of innovation across all R&D teams. An innovative framework is being put in place with the objective of boosting the emergence of ideas and the analysis of potential applications, with a focus on prototyping with the internal R&D research lab and via contests.
Amadeus is constantly leveraging major technology trends in the IT industry to innovate in the field of travel. Our purpose of shaping the future of travel translates practically into mastering and applying emerging techniques to foster new practices in how people travel and how the tourism industry will serve them more efficiently.

We pursue our endeavours in five strategic areas:

- Security. This is at the heart of Amadeus systems, both for the design of applications and for operations. Security of data is ensured by advanced techniques, including sophisticated methods of encryption for critical data. Amadeus has successfully renewed its PCI DSS security standards certification in 2013. System and application access is controlled by redundant mechanisms based on identification, roles and credentials, managed centrally for flexibility and integrity, since users are now accessing the applications via more channels (desktops, mobile devices, programming access). In 2013 Amadeus pursued (and will continue to pursue in future years) its commitment to world-class security by exploring and implementing advanced security methods, in particular in the field of user and device authentication, system-to-system access, and encryption of data in distributed environments.

- Massive data. The technical capability of handling extremely large volumes of data has been highlighted by travel providers as a key factor in drastically improving their service to customers, but also in optimising their operations. Advanced search is a domain of application of these techniques. Providers (airlines, hotels, etc.) are clearly moving to a contextual search whereby the price and availability of their product is based on the exploitation of data such as trip history, customer ranking, full view of the trip, as well as the identification of the requester and traveller, in order to dynamically create the best suited answer. This makes it possible to provide enhanced contextual services and customised offers. In 2013, Amadeus sponsored a White Paper by Professor Thomas H. Davenport (1) which highlights the practical applications of big data to the future of the travel industry. Amadeus is actively exploring advanced methods for fast storage and retrieval of massive data in distributed environments, based on emerging techniques such as NoSQL databases and grid-based distributed data. These solutions offer a simpler data model than the traditional SQL database, a distributed environment and a faster retrieval of data.

- Real-time analytics. In 2013, Amadeus R&D consolidated its team for travel intelligence, which encompasses all frameworks and applications for reporting and analysing data on a large scale. Data mining is a promising source of optimisation for travel providers, because it powers decision systems, dynamically adapting functionality to the environment; for instance, analysis of passenger traffic, customer behaviour when changing e-commerce applications, etc. Amadeus puts a particular focus on real-time analytics and invests in advanced and non-conventional database techniques to innovate in this field.

- Mobile. More than ever, travellers enjoy the power of mobile devices for arranging and controlling their travel. Amadeus has always been active in this field, and will continue investing in new forms of user interaction, including voice recognition and other methods becoming popular. With its central architecture, Amadeus can provide the traveller with ubiquitous access to data and transactions, whatever the channel used. In 2013 Amadeus developed the first version of a digital multichannel platform aimed at making the traveller’s life as easy as possible by providing them with the essential services they can expect at every step of the trip. In parallel, Amadeus also invests in mobility for travel professionals, as a mean of providing a better service, in particular during the trip.

- Cloud-based operations. This area includes the design, architecture and operation of applications capable of running in standardised low-cost, low-consumption hardware, potentially distributed across multiple data centres. This is a general trend in the industry, led by the biggest IT companies. Amadeus has already made substantial inroads in this direction, in particular with the trend towards open source and distributed architecture. We invest in cloud-based techniques in order to support the evolution towards massive data and wider geographical footprints. In addition, we manage highly transactional systems that require data integrity and accuracy, and therefore adapting the merging cloud architectures to these particular requirements.

For the particular trends highlighted above but also more generally in terms of all functional improvements developed in our applications, Amadeus is strongly committed to bringing innovation to its customers and beyond – to the travellers they serve. In this respect, we ensure our technology remains at the forefront of the industry.

---

**World-class technology**

The architecture of Amadeus systems is based on distributed open systems, with challenges regarding delivering and serving:

- Extremely high-performance transaction processing under stringent system availability, security and dependability requirements.
- Management of very large databases with full transactional integrity.
- Extra-fast response time for all functions, from any point of access in the world.
- Multi-channel customer servicing applications: agent desktops, websites, kiosks, mobiles, tablets, and increasingly more programming access (Web Services API).
- Hundreds of thousands of concurrent professional users (and even more end-consumers), with system access via a wide range of devices and methods.
- Large base of customers from small to large scale, with very diversified requirements and practices, all served from a single set of community applications.
- Wide range of applications and functional fields covered, for both distribution and IT, with the recent addition of airport IT and travel intelligence.
- Capability of maintaining and evolving all applications and system software during system running and ongoing servicing of customers.

This modern architecture is continuing its global migration to open source software as it becomes more and more powerful. This allows Amadeus to move away from proprietary software and hardware, and benefit from the latest technological evolutions brought by the IT industry.

We continue deploying a Capability Maturity Model Integration (CMMI) approach to software development. Amadeus has long been engaged in a patent programme for collecting and reviewing innovative propositions and coaching inventors in their drafting process. In 2013, Amadeus accelerated this trend and will continue this path in the future.

Thanks to our continued R&D investments, our expertise and leading solutions are widely acknowledged and respected by the travel and tourism sector’s leading players.

---

2 Open systems in computing and informatics refer to a class of systems built using open source software (OSS) standards and that offer a good level of portability and independence from the hardware platforms on which they operate, especially in contrast to the more entrenched mainframes that were common in the travel industry.

3 Application Programming Interface. A language that enables communication between computer programs.

4 CMMI is a process improvement training and appraisal programme used to guide process improvement across a project, division or an entire organisation.

---

### Open systems

<table>
<thead>
<tr>
<th>Amadeus technology and operational excellence</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>503 m</strong> bookings in 2013</td>
</tr>
<tr>
<td><strong>19,000+</strong> transactions per second</td>
</tr>
<tr>
<td><strong>&lt;0.5 sec</strong> average response time</td>
</tr>
<tr>
<td><strong>616 m</strong> passengers boarded in 2013</td>
</tr>
<tr>
<td><strong>400,000</strong> computer terminals connected</td>
</tr>
<tr>
<td><strong>2.5 exabytes</strong> of storage</td>
</tr>
<tr>
<td><strong>99.99%</strong> average availability</td>
</tr>
</tbody>
</table>
True partnership with the travel industry

When Amadeus was created 26 years ago, the decision was made to base our architecture and software development model on a partnership approach with two major objectives:

1. Airlines and travel agencies sharing the same core reservation functionality.

   Not only does this promote substantial synergies in the development of applications, but it allows the airline and the travel agencies’ respective direct channels to share common processes, practices and data, avoiding complex synchronisation of systems. This is extremely important for the convenience of the traveller, who is served by both and can benefit from a single view of his or her trip.

2. Amadeus serving a wide range of customers in the travel sector from a single core system, with the required adaptation and customisation for each customer.

   This approach is essential in evolving the Amadeus system to the global requirements of the industry, rather than individual customers. As a result, Amadeus applications are always in a better position to anticipate the major evolutions in travel, and combine their own power of innovation with the concrete real needs of all travel players. In other words, Amadeus works for the travel industry, via joint collaboration with our customers and partners.

These decisions were instrumental in giving Amadeus an advantage over our competitors, and today they continue to do the same.

R&D more than ever continues to keep Amadeus platform architecture compliant with these two objectives, which have the final goal of providing ‘solutions’ to our customers, comprising a combination of core components and services for integration.

Thanks to its synergetic architecture between Distribution and IT, Amadeus technology can serve all distribution channels. This is expanded to the deployment of Electronic Miscellaneous Documents (EMD), the formal records that keep track of the reservations and payments for these services. In 2013, Amadeus launched additional solutions around airline ancillary services and EMD.

Amadeus has a proven track record of working in partnership with our customers on large projects. We maintain formal dynamic customer communities with regular conferences as well as board and bilateral meetings to confer about product roadmaps, innovation and industry trends.

---

\[^{5}\] Airline ancillary services can be defined as additional services provided to customers beyond the airline ticket. Typical examples include baggage fees, priority seating, on-board catering, etc.
Putting the Passenger first

A customer-centric approach to irregular operations

Passenger perspective

- ‘Mild’ delays cause inconvenience and negative sentiment
- Passengers expect compensation regardless of what caused the delay

Growing markets

- Chinese travellers are most likely to share a negative travel experience with friends, family and on social media

The real impact of irregular operations

- Reputation damage from angry passengers on social media
- Lost customer loyalty from those who missed important appointments
- Cost of fuel, crew and aircraft maintenance and ownership
- Impact on load factor if travellers ignore re-accommodation and find their own alternative

Towards a standard service approach

- Procedures and processes incorporated into daily operations
- Collaboration between airlines
- Communication between airlines and airports
- Airlines need to equip themselves with the right technology

Case study: Disruption management solutions

Whether due to delayed or cancelled flights, passenger disruption affects all types of airlines. Amadeus provides solutions that minimise the impact at passenger travel – whether in terms of the journey, services, luggage or documents, such as e-tickets and EMDs (Electronic Miscellaneous Documents).

Managing disruption covers all the steps of the journey, from information management within airlines’ Operations Control Centres (OCC) to passenger compensation and claims. Thanks to our disruption management solutions, Amadeus provides streamlined processing for faster flight, passenger and document handling, less compensation expenses, more accurate solutions, and higher volumes of automation for complex re-bookings. Travellers have an improved customer experience thanks to our proactive notifications via kiosks, mobile phones and the internet.

In 2013 Amadeus published research conducted with travel market research company PhoCusWright ‘Passengers first: Re-thinking irregular operations’, which encouraged airlines to re-think their disruption management strategies by placing the passenger at the forefront of their decisions and processes. We also actively take part in relevant industry forums – Future Travel Experience, AGIFORS Airline Operations, IATA Fast Travel Program - and liaise with major regulators such as the European Commission, A4A (Airlines for America) and IATA.

Improved disruption management provides flight optimisation for airlines and airports, improving economic and environmental performance. Moreover, improved and optimised solutions also positively impact the end-traveller, which overall adds up to a contribution to the sustainability of the industry.

See ‘Amadeus in the travel industry’ p. 14
Industry reports and White Papers

Being on the front line of one of the world’s largest industry means that we are always striving to be at the forefront of thought leadership initiatives. Research and innovation is part of our DNA here at Amadeus and a multitude of industry-leading White Papers support this. Our research papers for 2013 are available for download from the Amadeus website:

**Shaping the future of travel in Asia-Pacific**

Shaping the future of travel in Asia-Pacific involves four key themes, or ‘The Big Four Effects’ that will drive significant change in the Asia-Pacific travel ecosystem over the period to 2030.

Developed by business research and consulting firm Frost & Sullivan, this study surveyed 1,531 business and leisure travellers across the seven key markets of Australia, China, India, Indonesia, Japan, Korea, and Singapore. Beyond quantitative traveller research, Frost & Sullivan also conducted 13 in-depth executive interviews with industry thought leaders from the Asia-Pacific region. What this research and White Paper undeniably highlights is the opportunity that Asia-Pacific now has to regain a leading position on the global stage that reaches well beyond travel, but to which it is inextricably linked.

**The Rail Journey to 2020 Report**

Showcasing the facts, figures and trends that will define the future of European passenger rail – this report focuses on the period up to 2020, which will see the industry impacted by an unprecedented combination of factors. The Rail Journey to 2020 Report estimates that long-distance passenger traffic will increase by 21% (2.2% annually) to reach over 1.36 billion by 2020, 238 million up from the 2011 figures. This anticipated growth in passenger volume will be driven by four key markets in particular: the United Kingdom, France, Switzerland, and Germany.

The report concludes with comments on how passenger rail operators can take advantage of the trends transforming the industry landscape, and position themselves to benefit from opportunities that currently lie beyond their borders.
At the Big Data Crossroads: turning towards a smarter travel experience

This independent study, authored by Professor Thomas H. Davenport, highlights that the industry is at a big data crossroads: large-volume, complex and unstructured datasets are beginning to reshape the industry and so the development of big data initiatives is now a priority for many.

What is it that makes big data such a powerful idea? First, big data can provide insights that help deliver a more intelligent travel experience than has ever been possible. Whereas structured data has historically been divided between different silos, big data, harnessing both unstructured and structured data promises a more integrated view of our industry. This offers travel companies the opportunity to enhance current industry processes, push innovation and build better relationships with their customers.

There is an equally important opportunity to ‘put the fun back into travel’, which at its very heart is about improving the passenger experience. Big data can help to make travel more responsive and focused around traveller needs and preferences.

As highlighted in the study, big data can be the foundation for greater industry-wide innovation. Big data demands big ideas and the courage to implement them. Managing and analysing data is no longer an issue for the IT departments alone – instead it is driving the travel industry’s business agenda.

A Digital Savannah: Africa’s e-commerce promise

This White Paper identifies five key trends shaping decision making and consumer behaviour as they relate to online shopping preferences and travel booking. The major trend identified is a healthy appetite for online shopping, although the way it is conducted tends to differ significantly from traditional e-commerce systems.

This is particularly so in the travel sector, where more than half of companies surveyed currently book online and another 20% are expected to do so in the near future.

These results are contained in the independent research paper ‘A Digital Savannah: Africa’s e-commerce promise’. The study was authored by Arthur Goldstuck, CEO of World Wide Worx, and is the first in-depth look at trends and opportunities in the e-commerce space in Africa.

Passengers first: Re-thinking irregular operations

‘Passengers first: Re-thinking irregular operations’, commissioned in partnership with PhoCusWright, looks at this pressing issue and explores the true impact of irregular operations with a focus on understanding the traveller’s perspective and providing practical strategies for airlines to better manage customer expectations.

The report addresses five key questions for airlines that seek to improve irregular operations management including:

- Have you considered incorporating a standard service approach to deal with passenger journey disruptions?
- Would you be able to build a schedule that can accommodate unplanned events?
- Are you prepared to implement a passenger-centric solution that empowers passengers to choose alternatives most relevant to their needs?
- How transparent are your communication and compensation practices?
- Do you have the infrastructure to analyse relationships within social media platforms?