Mindtree
Welcome to possible

Customer centricity in airline industry.

Summary

In airline environments, information is collected for archival and historical purposes from a wide variety of sources. This creates a repository of data that is, perhaps, the most valuable asset for an airline. However, the challenges of managing and extracting information to aid an airline is increasingly difficult to resolve due to customer centricity. Siloed databases / data marts and the information they contain are typically bound to the software subsystem within an enterprise's application, computing platform, or IT environment. To complicate matters, as businesses implement new, dissimilar technologies, the problems of inconsistency increase. The result is isolation. Making it difficult to find, deliver, assemble, or use information sources for knowledge that supports business needs across the enterprise.

The purpose of this paper is to highlight the need for a real-time data warehouse coupled with an analytics engine within the airline's IT environment. This mission critical system would ease the pressing needs of customer centricity and e-business.

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Introduction

About ten years ago, Continental Airlines was faltering and ranked among the lowest of the major US airlines. The problems the airline faced were not unique. But, siloed, unstructured data and incomplete information made determining the root cause analysis a difficult task.

Continental Airlines needed a more comprehensive view of the business in order to reduce operating expenses, increase commercial insights and improve time-to-market. Here, too, legacy systems were hampering the growth and profitability story.

In the past decade, there has been a substantial investment by airlines to mothball their legacy systems and move toward a modernization strategy. Some airlines realized substantial benefits by making investments in real-time data warehousing and analytical solutions. Notably, Continental Airlines produced an ROI of over 1,000% with $500 million in cost savings and revenue generation over a six year period.

The challenges for implementing a real-time data warehouse are not alien within an airline environment. Real-time flight data feeds from flight operating systems and either flat-file or XML data feeds from the CRS are two solid examples of velocity and variety-related challenges that real-time Data Warehouse and Business Intelligence (DWBI) systems have to surpass.

For many airlines, their current infrastructure is legacy in nature and moving to a new generation of data integration and business intelligence is an added level of complexity. Scandinavian Airlines had to move from a legacy mainframe and DB2 infrastructure in order to implement a 4th generation data integration and business intelligence application.

Even though there is tremendous complexity around the large volume of data airlines produce, real-time DWBI implementation is the need of the hour. With real-time DWBI systems, historical reporting is enabled over a longer period of time, with an increased level of granularity.

Current state

Traditional systems that are deployed for airlines around the world are siloed and very ad-hoc in nature. Rarely do these systems share data in an economical manner. If they do, they are piecemeal extracts after the fact. Ideally, data generated by all operational enterprise systems and partners across an enterprise should be automatically archived and indexed. Regardless of the application or platform that created the data. Airlines should also be capable of searching the entire corporate database to retrieve the relevant data. Airlines need the right information at the right time, with the right degree of accuracy.

For the airlines at this new frontier of innovation, competition and productivity, it's about analyzing masses of unstructured or semi-structured data. This, until recently, was considered too difficult, too time consuming and / or too expensive. But, as airlines get closer to their customers, they gain insight from looking at interaction patterns throughout the customer journey.

Typical attributes of airline data can be identified by four main attributes:

1. **Volume** – Airline data is massive. Typical tier 1 carriers and Global Distribution Systems (GDS) have Passenger Name Record (PNR) data measured in terabytes.
2. **Velocity** – Airline data is real-time and arrives quickly, making timely decisions difficult.
3. **Variety** – Ad-hoc systems traditionally have different structures and shapes. Data analysis on such data is difficult because of rigid schemas.
4. **Value** – Airline data on its own is low value until it is rolled up and analyzed. At this point data becomes information which, in turn, becomes knowledge for the broader market.

Storing and analyzing data is key for airlines to address customer satisfaction and achieve additional revenue to support ongoing operations. Not doing so leaves the airline enterprise struggling for insightful information that can transform customer experience. For example, an airline with separate data marts for ticketing and flown PNR / DCS data can analyse the separate data marts and provide answers to questions pertaining to that function. However, combining the data marts enables new cross-functional insights that cannot be achieved with the siloed approach. By combining ticketing and flown PNR / DCS data with inventory and flight schedules, a wealth of information becomes available, enabling fact-based, value-added decisions.

Some key areas where real-time analytics play a vital role within airlines are:

Management of the seat factor
- Overbooking capacity to ensure maximum seat factors with minimal off-loads and downgrades

Management of the revenue mix
- Cabin mix via market segmentation
- Seat access and group acceptance

Loyalty management
- Identifying the different clusters of customers
- Targeting clusters with appropriate messaging, promotions and placement to ensure repeat revenue and reduced churn

Cargo management
- Cargo capacity / demand planning
- Cargo rate optimization
- Cargo load optimization
- Pallet management
- Pricing optimization

Passenger business
- Missed connections
- Lost baggage
- VIP customers
- Up sales during the booking process
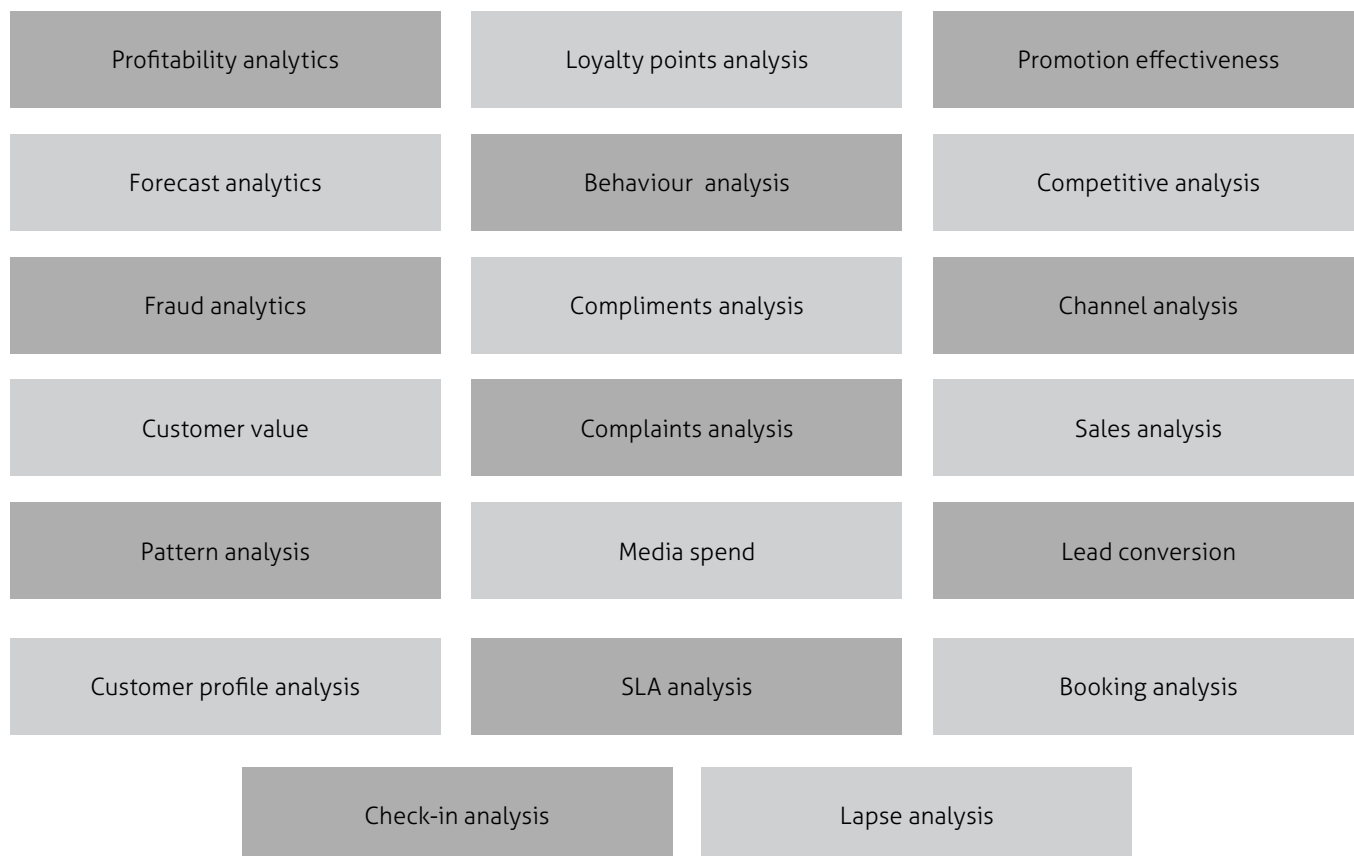- Overhead bin space optimization

Flight operations
- Aircraft re-routing
- Gate management
- Baggage management
- Parts management
- Forecasting
- Flight catering management
- Ground handling services
- Manpower planning
- Optimized staffing levels

Others
- Sales area
- Managing traffic flows (O&D)
- Brand buzz analysis
- Sentiment analysis

Key areas where real-time analytics play a vital role within airlines.

Profitability analytics	Loyalty points analysis	Promotion effectiveness
Forecast analytics	Behaviour analysis	Competitive analysis
Fraud analytics	Compliments analysis	Channel analysis
Customer value	Complaints analysis	Sales analysis
Pattern analysis	Media spend	Lead conversion
Customer profile analysis	SLA analysis	Booking analysis
Check-in analysis	Lapse analysis	

Airlines industry IT trends

Having touched upon the impact and the absolute need for a world class Real-Time Data Warehouse Business Intelligence (RTDWBI) and analytics solution for the airline industry, it is critical to understand key IT trends in this industry that make the initiative even more important:

- 56% of airlines will make R&D investments in passenger services via social media
- 52% of airline companies will consider business intelligence as their major IT investment program in the next three years
- 57% of airlines believe social media provides the greatest value as a marketing channel
- 78% of airlines personalize service offers to their passengers though direct channels

Clearly, the focus of airlines beyond 2015 is to ensure maximization of sales through websites and smart phones. Service personalization, as well as efficient operation, depends on the availability of data for analysis. Hence, the sharing of data between stakeholders becomes essential. In recognition of this dependency, around half of the airlines already share or are planning to share data with third parties.

The SITA airline survey results clearly indicate that the velocity and volume of data for the airline industry is going to increase drastically in the next few years. Therefore, airline enterprises need to prepare with a robust intelligence infrastructure. So they not only manage growth, but also stay ahead of competition by their ability to abstract insights from large volumes of data.

Real time business intelligence and analytics

One of the simplest ways to increase intelligence in operational systems is to embed simple business rules and models. They could then help analyze transactional data on the fly and provide alerts triggered by specific events or threshold limits. Of course, care should be taken not to create performance bottlenecks on mission critical operational systems. However, this approach would not match up to the analytics that could be modelled over an integrated enterprise data warehouse with change capture enabled as a key differentiator.

Most data warehouse designs implemented for airlines are designed for daily, weekly, or monthly data refresh from underlying source systems. So it would take an entire day for changes in the transactional systems to be loaded into the data warehouse, ready for business users to view via the business intelligence platform. This is not useful for airlines that need real-time intelligence and analytical capabilities. Real-time capability is the missing piece of the puzzle that allows airlines to react to real-time events, such as helping ground operations support potentially delayed passengers due to incoming flights. Furthermore, real-time capabilities provide alerts and triggers to measure tactical, operational and strategic key performance indicators to analysts.

A real-time data warehouse enables the warehouse to extract, transform and load data almost immediately after the transactional system gets updated. Thereby enabling business users to get the latest view of their enterprise data in an integrated, single version at any point in time. Latency in a real-time data warehouse is in sub-seconds as opposed to incremental daily or intra-day loads. However, if data needs to be loaded continuously in real-time, there are a few design challenges to be overcome:
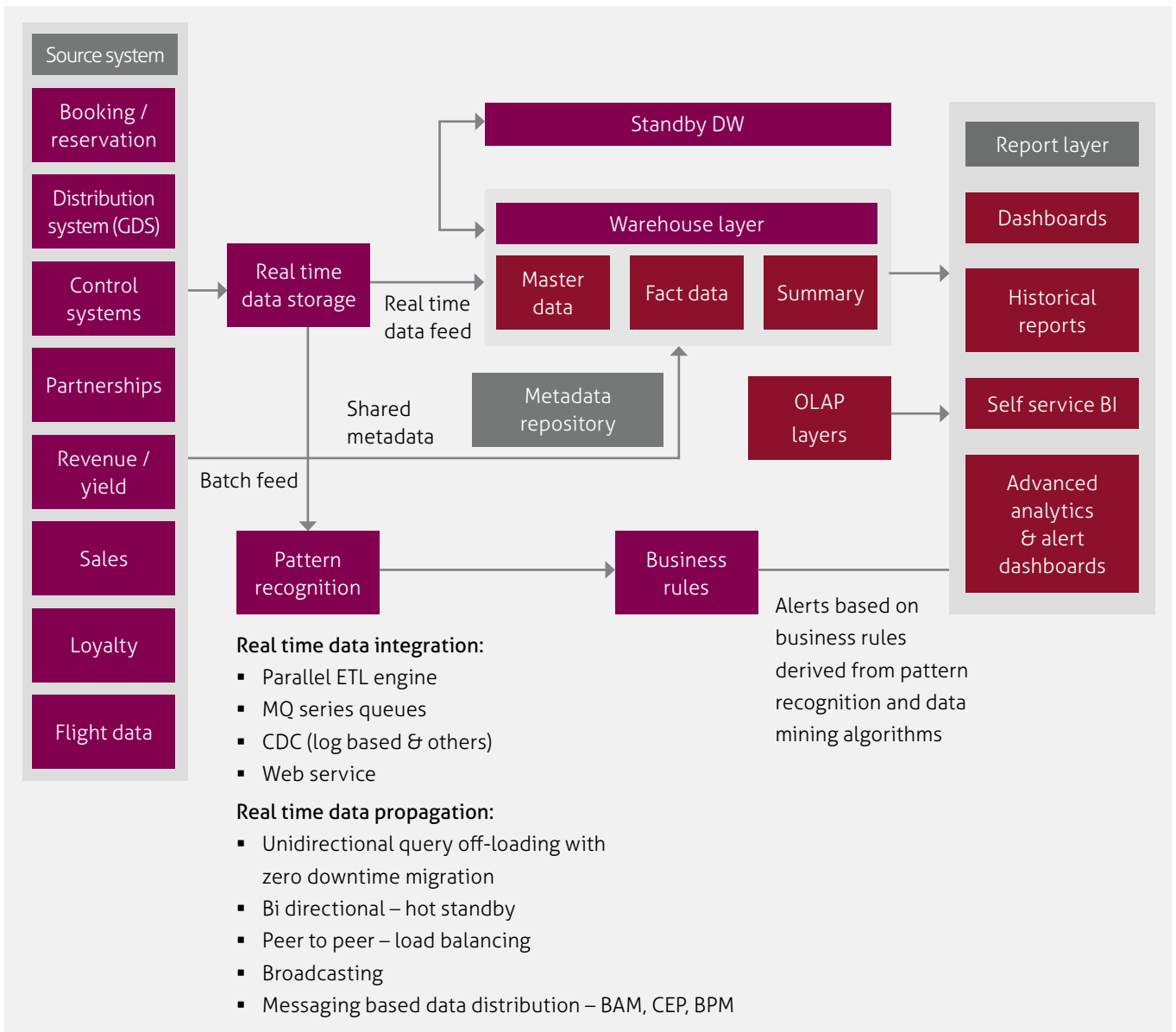
- No room for system downtime and, therefore, disaster recovery is a hurdle
- If the data changes faster than the query response, erroneous responses could be displayed (refresh anomaly)
- Data sync is a problem because loading data to a fact table happens several times a day, while dimensions are only loaded nightly
- Scalability could be an issue if not handled early enough during the architecture phase

High level architecture

The majority of airlines intend to leverage websites, smart phones and social media as the preferred sales channel. A surge of data is therefore expected to flood transactional systems, in increased frequency and varied formats. This will make data feed into the upstream data warehouse even more challenging. The triple V – Volume, Velocity and Variety – constraint will define the future landscape of large scale DWBI applications.

Real-time DWBI architecture needs to address extracting, transforming and loading, as shown below (Fig. 02):

Fig. 02. Real-time DWBI architecture showing extracting, transforming and loading.

Source system
- Booking / reservation
- Distribution system (GDS)
- Control systems
- Partnerships
- Revenue / yield
- Sales
- Loyalty
- Flight data

Real time data storage

Real time data feed

Batch feed

Standby DW

Warehouse layer
- Master data
- Fact data
- Summary

Shared metadata

Metadata repository

Pattern recognition

Business rules

OLAP layers

Report layer
- Dashboards
- Historical reports
- Self service BI
- Advanced analytics & alert dashboards

Alerts based on business rules derived from pattern recognition and data mining algorithms

Real time data integration:
- Parallel ETL engine
- MQ series queues
- CDC (log based & others)
- Web service

Real time data propagation:
- Unidirectional query off-loading with zero downtime migration
- Bi directional – hot standby
- Peer to peer – load balancing
- Broadcasting
- Messaging based data distribution – BAM, CEP, BPM

As mentioned above, a few design challenges need to be overcome. The architecture should account for no system downtime. Because data changes faster than a query response, users could be faced with "refresh anomaly". Data sync needs to be addressed, as the loading of data into fact tables occurs several times a day, whereas dimensions are only loaded nightly. Database backups become cumbersome to the real-time nature of the warehouse. And finally, scalability could become an issue.

Fortunately, solutions and design approaches currently available can help overcome the challenges of implementing a real-time data warehouse.

For data loading and replication, there are tools like IBM DataMirror, Oracle GoldenGate and MetaMatrix that support real-time data movement into a warehouse. Enterprise Application Integration (EAI) vendors such as Tibco, Mule Enterprise Service Bus (ESB) and IBM WebSphere Message Broker (WMB), leverage a Service Oriented Architecture (SOA) and provide solutions for real-time data transport. Incremental data load design could be applied using Change Data Capture (CDC) techniques such as log-based and time stamps, database triggers and message queues (e.g., IBM MQ series).

Data federation tools can provide data abstraction. This enables users and clients to store and retrieve data in multiple non-contiguous databases with a single query, even if the constituent databases are heterogeneous. Enterprise Information Integration (EII) ensure that the provision of a federated query server can retrieve and integrate data from multiple data sources. Including unstructured data and message queuing software. Some key EII products include Actuate Enterprise Reporting Platform (ERP), BEA Liquid Data, Composite Software Information Server, IBM DB2 Information Integrator and MetaMatrix server.

Data could be combined from multiple sources, making it accessible with a simple service call using a common XML or JSON format. Systems based on the latest Java technologies (Java Messaging Service) could be used to transmit each new data element from the source system to a lightweight listener application. This in turn inserts the new data into warehouse tables. Data received over the Internet could be transmitted in XML via HTTP using the Simple Object Access Protocol (SOAP) and then loaded into the warehouse. Data caching techniques could be leveraged, e.g., page caching, tag caching, template caching and dynamic channel query caching.

Eventually, it boils down to two things: the right kind of experience and expertise-led design implementation; and leveraging the latest technologies supporting a real-time data warehouse and business intelligence application. Some key features of a data warehouse appliance include:
- Real-time query and loading
- MPP architecture
- Automatic high availability
- Aggressive data compression
- Extensible in-database analytics framework
- In-database analytics library

Pre-packaged DWBI framework

Apart from product vendors, Mindtree builds solutions and frameworks for the airline industry. Our custom airline industry offering is called Real-time Airlines Predictive Intelligence Design (RAPID) framework. It is based on our vast experience in building DWBI and analytics solutions for leading airlines around the world. The RAPID framework offers Mindtree's Intellectual Property (IP) assets for the airline industry and the IP stack includes:
- Airline data model
- Airline analytics models
- Predefined airline dashboards
- Integration of airline data model to standard industry source interfaces

This framework reduces implementation time by two-thirds of a full blown development effort, helping airlines realize ROI much sooner.

As with all frameworks, customizations on the data model, ETL, reports and dashboards cannot be ruled out. Further maintenance includes regular updates to the analytical models based on on-going accuracy measurements.

Mindtree is currently moving ahead on the roadmap to enhance and host the RAPID framework as a trademark industry solution for the airline industry. Starting with DWBI and big data analytics (a process of examining large amounts and different types of data to make better business decisions) on a cloud platform.

Conclusion

Analytics has been defined as, "The extensive use of data, statistical and quantitative analysis, explanatory and predictive models and fact-based management to drive decisions and actions." (Davenport and Harris, Competing on Analytics, 2007).

Airlines have been traditional users of analytics in terms of dynamic pricing, optimum capacity and utilization of cargo allotments, to name a few. But today's competitive environment is filled with an influx of low cost carriers, an increase in cross-border players and an ever-changing pool of consumer desires. This makes the understanding of customers and the business landscape utterly important for survival. With the co-joined service offering of real-time data warehouse and analytics, airlines have another very important tool at their disposal to bring to market enhanced customer centricity and e-business.

Apart from American Airlines, most of the other airlines in the US have reported profits this past quarter. The race is on for airlines to win and retain each and every customer. This means they not only need to cater to customer desires, they also need to understand how competitors are wooing their customers. Stickiness with airline customers is even more important now. It's an oft repeated lie, "Airline service is a commodity to consumers". Airlines can no longer behave as a mere commodity. A huge part of stickiness depends

on customer experience at the various touch points in the customer journey.

Airlines need to see the journey through the eyes of the customers. Countless books and research articles have been written about customer interaction.

Many airlines have even gone as far as identifying all the touch points. But very few have implemented a unified customer experience. Each touch point might just as well belong to any other airline; there is no uniformity or point of view. This points to a very important fact – many airlines are yet to map out the customer journey as a customer retention strategy. Airlines still have the opportunity to reach out to their customers and provide them with an experience is relevant and makes a difference. Each customer has a story to tell that's good, bad, or indifferent. Chances are that good stories lead to customer stickiness. These are the moments of truth that differentiate one company from another. In the airline industry where customers don't see any difference between one airline and another, the level of service can't be average. Imagine this – Southwest Airlines has about 500,000 moments of truth. Every moment on the customer journey leads to customer stickiness. Anthony O. Putnam, in the book, "Marketing Your Services," says, "Alignment comes from getting all your energy focused on one direction – in making sure that everything you say and do is congruent and seen that way by your clients."

Real-time DWBI can positively impact airline operations, greatly increasing customer centricity and satisfaction. It's critical to understand that real-time data warehouse and analytics support the key strategies of the airline business, namely supporting enterprise vision and their goals.

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About Mindtree

Mindtree is a global information technology solutions company with revenues of over USD 400 million. Our team of 11,000 experts engineer meaningful technology solutions to help businesses and societies flourish. We enable our customers achieve competitive advantage through flexible and global delivery models, agile methodologies and expert frameworks.