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# A data driven approach for Customer Relationship Management for Airlines with Internet of Things & Artificial Intelligence

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## Abstract:

Customer Relationship Management is a critical aspect for all service industries and extremely important in aviation industry. With the changing aviation scenario, the travel industry is facing more challenges. Identifying and retaining the profitable customers is very essential for survivability. Customers are well informed about the services that offer them the maximum value proposition and retaining high value customers is very challenging. Airlines currently use many techniques for CRM, but there are drawbacks in the system which can be complimented with emerging technologies. Artificial intelligence & Internet of Things are evolving domains, which have gained lot of importance during the last decade, predominantly due the capacity of systems to gather, store, process & transfer huge amount of data. This paper is indented to improve CRM with the prudent use of AI & IOT and involve airports in implementing smart CRM, ensuring long term profitability and sustained revenues.

**Keywords:** Smart Customer Relationship Management, Smart Airport, Internet of Things, Artificial Intelligence

## 1. Introduction

Customer relationship management (CRM) is a critical factor across all the service industries. CRM is defined as the approach of managing an organization's interaction with its current and potential customers based on customer data, collected from customer's interactions with the organization. The customer data is analyzed using specialized tools to improve relationships with customers, focusing on customer retention and generating additional revenues. The data required for CRM comes from different communication channels, like official website of firm, call centers, emails, combined loyalty programs with other organizations etc. Recently many organizations have started data mining and use of social media to gather customer information, so that better service can be offered to the customer. Whatever be the CRM implemented by the organization, data and accurate analysis of data is very critical for successful CRM implementation.

Airlines are operating on very narrow margins due to competition and global economic crisis due to pandemic. Many airlines are trying to reduce the operating costs by improvements in operation, optimization of fleet and routes and reduction in manpower. However, customer cannot be ignored in the process of regaining operational efficiency. The core service for all airlines is providing basic

transportation. All other services like choice of in-flight entertainment, onboard meals, quality of cabin crew, special assistance etc are supplementary services aiding the core service. Supplementary services help in product differentiation of the core product and create a competitive advantage by facilitating the use of core service and enhancing the value of the core service. To retain customers and improve customer retention, emerging technologies can be used, which can assist airlines in enhancing both the core and supplementary services. An airline's effective CRM program can be a significant factor for sustainable revenues, product differentiation, achieving operational efficiency and long term growth of the organization.

Research towards new paradigm shift for customer relationship management in airlines was carried out by IBM institute of Business Value [1].The use of data and data mining techniques for customer relationship management [2] has been researched. Studies on behavior of airline customers based on their perception of choice and importance of those factors to develop the appropriate marketing strategies were also carried out [3]. CRM studies at regional level for different airlines at was also done by many researchers [4 5 6]. Many airlines uses social media for data collection and improvements in CRM [7 8 9 10].However, CRM methods are on the verge of radical changes with emerging technologies [11 12 13 14]. This paper tries to propose a smart data driven method for improvement of CRM with prudent use of Artificial Intelligence and Internet of Things and make an airport a key stakeholder of CRM activities.

## 2. Research Methodology

The research started with interactions with some customers who travel frequently on international airlines, and it was observed that frequent travelers mind each small factor in service of airlines and are not hesitant to switch their loyalty. The existing CRM systems followed by airlines were analyzed and to understand how major airlines try to retain the customers and what are the drawbacks in these systems. Interviews and surveys were carried out among customers to understand the major factors that causes passenger to switch the airlines. The scope of emerging technologies like AI and IoT was further investigated to improve the CRM. The research methodology is briefly described in Figure 1.

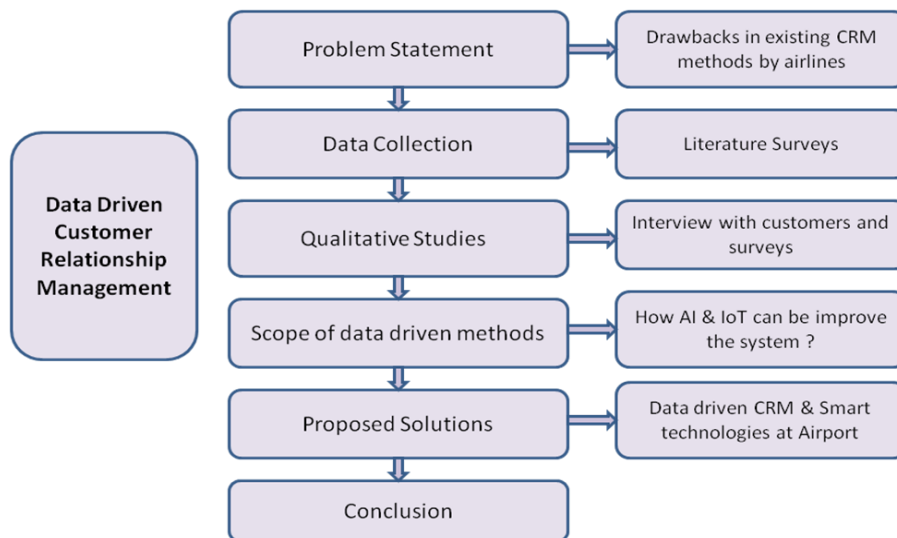


Figure 1: Research Methodology

### 3. Importance of CRM for Airlines

Customers are profitable over a period of time and studies shows that profit can increase by 35 to 85 percentage by retaining just 5 percentage of customers[15]. Getting a customer and retaining him as a loyal customer in long term is an extremely challenging, but highly rewarding activity for airlines. Identifying a potentially profitable customer is a tricky task as customer has lot of options for travel. Airlines use different ways to collect customer information. Most of the airlines use loyalty programs individually or as a group of airlines to get customer data and use them for customer relationship management activities. Promotional offers, discounted rates, upgrade of travel class and accessibility to premium facilities are provided to customers based on this data to retain the customer. But there are few drawbacks in the existing method of implementation of CRM based on loyalty programs.

**Table 1** shows the behavior of a passenger X, who made 4 international journeys from Bangalore International Airport Limited (BIAL) in a year to different destinations using different airlines all the times. The passenger has also made multiple journeys inside the country which has not been considered for the analysis.

**Table 1:** Typical Passenger Travel Pattern

Si No	Origin	Destination	Airline	Mode of booking	Feedback
1	Bangalore	City A	A	Official website	Very disappointed with baggage handling of the airline and decides not to fly with this airline anymore.
	City A	Bangalore	A		
2	Bangalore	City B	B	Travel Portal	Prefer Airline B, though it's a connection flight and happy with the experience. Not booking return on this airline as it's a long connection. Booking was not linked with official site as travel portal offered free seat selection.
	City B	Bangalore	C	Travel Portal	Very unhappy with Airline C, due to poor care provided to kid and lack of inflight entertainment (IFE) on the connection flight. Booking was linked with official portal for seat selection.
3	Bangalore	City B	D	Official website	Prefer Airline D as it is the fastest flight on route. Compromises on IFE contents of the European carrier, but travels by business class.
	City B	Bangalore	D	Official website	
4	Bangalore	City C	E	Official website	Prefer Airline E as it's the fastest direct flight and travels by business class
	City C	Bangalore	E	Official website	

A few points can be clearly understood from the travel pattern.

- A passenger may use different channels for airline ticket booking. It can be the airline official website or mobile app or third-party travel portals or agents, depending on the convenience and cost. So the data obtained from the official sites alone is not sufficient to understand the travel pattern of a customer.
- Travel history at Si No.1 shows after travelling, the customer has decided not to travel by the airline anymore. The data indicates that the passenger had used the official app for booking ticket on the airline (Airline A). The booking was done for a higher fare compared to travel portals, but it was done due to convenient procedures for visa approval. But the baggage experience with the airline was very poor, which made the customer decide that he will not prefer this airline anymore. The customer has done lot of travel after that, but never preferred this airline again. Airline keeps sending mails and promotions in the passenger's mail, without any response. In this case, the airline A is not aware of losing the customer and why the customer switched.
- Travel history at Si No.2 shows booking on third party portal as the inward and outward journey was done on different airlines and customer preferred paying in his local currency. Onward journey shows passenger was extremely happy with Airline B, because of the special attention provided to the kid, quality of food and the choice of in-flight entertainment. He may prefer this airline on future journeys. But as the booking was done on third party site and not linked to any official site, the airline is unaware of a happy and satisfied customer.
- The return journey of this trip is on a different airline (Airline C). The customer linked his booking to the official site for choice of seat and registered to the loyalty program. But as the customer was not satisfied by the cabin crew service offered by the airline, particularly the delay in serving meals to the kids travelling along with, this airline was never preferred again. The customer was also unhappy with the seating comfort, and the lack of in-flight entertainment provided on the connecting flight. The passenger has made journeys after that, but never preferred this airline. This airline also is unaware that it has lost this customer, but still tries to attract the customer with constant communication, as he has registered in loyalty program.
- Travel history at Si No 3, indicates travel to the same destination, but on a different airline (Airline D). Previous journey also, the customer wanted to book on the same airline, which was the fastest mode of travel on that route. But it could not be done because the journey was planned in a short time and the cost offered by the particular airline was very high compared to fare offered by connection flights. When the customer got sufficient time to plan his next journey, he booked it on the Airline D. The customer was happy with the timings and food, but slightly unhappy with the in-flight entertainment and seating & cabin comfort provided by the airline as this was an old aircraft. But the customer has travelled on business class compared to his previous journeys in economy class.
- Travel history at Si No 4 indicates, the customer has developed his travel

choices and is ready to spend more money for travel and his comfort. Again the passenger prefers to fly on business class.

All the airlines mentioned in the case have their own loyalty programs and methods of data collection which act as the base for CRM implementation. The customer here can be considered as a profitable customer based on the travel pattern and willingness to spend. Airline A & C, who still try to attract and retain the customer are clearly losers in this context. Airlines B, D & E haven't lost the customer, but even these airlines have to be careful with CRM to retain this customer and offer the best services.

No CRM methods currently used by airlines can predict this type of customer behavior. The customer mentioned in the case has the potential to become a profitable customer, but drawbacks in the system fail to identify him as a profitable customer due to deficiency in data collection and identifying the reasons for the passenger to switch between airlines. There can be improvements to CRM with use of emerging technologies like Artificial Intelligence & Internet of things, which can be a game changer for airlines in long term.

#### **4. Improved Smart Data Driven CRM for Airlines**

The airline market is oligopolic with many airlines providing more or less similar services to the passenger, which make the competition very high and choice abundant for a passenger. An airline with an efficient consumer-centric approach to relationship management will be better positioned to acquire, develop and retain high value customers. An airline's CRM program is the key for product differentiation, achieving operational efficiency and long term business development. To achieve this, the airline has to clearly understand what prompts a customer to switch the airline and who has to be treated as a high value customer.

Decision by a passenger on which airline to travel depends on a lot of factors like cost, convenience & other amenities. The initial choice of an airline by a passenger can be mostly advised from travel agents or friends or based on internet research. Once the passenger uses the airline, he gets a real feel of the services offered by the particular airline. After a journey, a passenger may be fully or partially satisfied by the services offered by the airline or may not be satisfied by the services. Once the passenger is not satisfied, he may decide not to travel by the airline any more or prefer it as the last option.

This paper focuses on two major factors that require attention in CRM and how CRM can be improved by use of emerging technologies ensuring long term revenues.

- i. Identification of the factors which results in dissatisfaction to the customer and loss of business and how these can be improved with emerging technology concepts like Internet of Things (IOT) and Artificial Intelligence (AI).
- ii. Identification of the high value passengers based on travel history by using advanced technologies at the airport. An airport has to become smart airport using technologies like face recognition and become a centre for data collection.

#### **5. Factors leading to customer dissatisfaction & loss of business**

There are many factors which make a passenger feel dissatisfied by an airline. Identification of factors leading to passenger rejecting an airline was arrived based on surveys and interactions with passengers. For many passengers, cost of travel was the

major factor deciding choice of airline. But there are lots of passengers who are willing to spend little more for comfort and convenience. Airlines have to focus on such passengers for sustained revenues, while not neglecting the cost conscious passengers. Figure 2 shows revenues from a small percentage of high value customers are much higher than the revenues from other passengers.

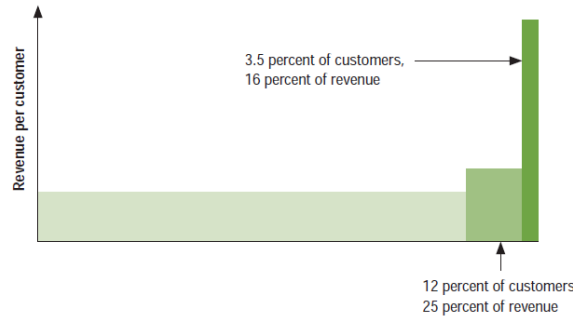


Figure 2: Airline Customer Value (IBM Analysis)

The core service for airlines is to provide basic transportation. Other services like in-flight entertainment, onboard meals, quality of cabin crew, special assistance etc are supplementary services aiding the core service. A flower of service model, shown in Figure 3 was prepared based surveys and interaction with passengers.

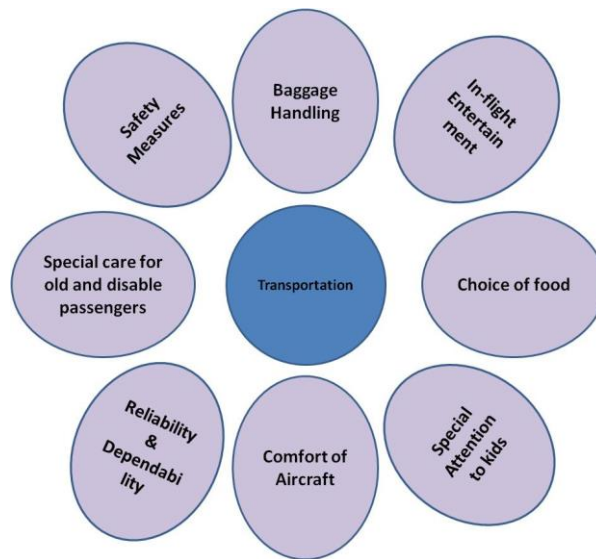


Figure 3: Flower of Services for Airlines

The importance of these factors and why these supplementary factors can cause passengers to switch airlines are provided in **Table 2**.

Table 2: Key reasons for customer switching in Airlines

Factor	Remark
Baggage Handling	Baggage of a passenger is important and requires very careful handling. Loss of baggage, delay in baggage, damages to baggage and theft of items from baggage are few things which create a poor opinion about an airline in customer's mind and can result a customer avoiding an airline. The number of mishandled bags in 2018 was 24.8million according to SITA.[16] Out of 24.8million bags mishandled, 18% are damaged and pilfered bags and 5 % are stolen. Transfer mishandling is a major reason for delayed bags.

Factor	Remark
In-flight Entertainment	A passenger spending lot of time in aircraft requires entertainment. The choice of in-flight entertainment varies from passenger to passenger and it is dependent on the country of origin, age, personal preferences. Providing good in flight entertainment is an important supplementary factor in passenger retention.
Choice of Food	Food option on board is another complex factor that needs attention of airlines. The choice of food also varies from passenger to passenger and depends on many factors. Many airlines cater different options of food, but majority of passengers do not provide the choice of food to airlines prior travel. This sometimes leads to situation in which some dishes are not sufficient and some of dishes are wasted.
Special Attention to Kids	An airline that does not provide special attention to kids has all chances of losing a family passenger. There are many parents who consider the care provided to kids as a very important factor for air travel.
Comfort of seats	Comfort of a seat is very important in long haul flights. Seats lose its comfort as the aircraft ages and can result in discomfort to the passenger and rejection of airline by passenger as the passenger may prefer a new comfortable aircraft.
Type of aircraft/age of aircraft	There are many passengers who are technically knowledgeable and can select the aircraft based on the seating layout, cabin pressurization, humidity etc. Offering an uncomfortable or old aircraft to a technically educated customer may end up in losing the customer.
Reliability & Dependability of the airlines	Issues like delays in journey, trip cancellations also lead to customer dissatisfaction. In many cases, passenger loose connection flights due to delay in one leg of the journey.
Special care for old aged/ sick and disabled passengers	There are passengers who are old, disabled and suffering from medical conditions who require special assistance for travel. The requirement of these passengers includes wheel chairs and personal attention till the journey is completed. The airlines have to provide preferential treatment to these passengers in coordination with airports
Safety	With emergence of pandemic, safety has become a major concern for most of the passengers. Passengers require clean and sanitized cabin for safer travel, which has become a standard norm for travel. Cleaning and sanitizing the cabins as per standard safety norms adds additional costs to airlines, increase the turnaround time and reduce the operational efficiency of the airlines.

## 6. Use of Emerging Technologies for enhancing Customer Experience

Many of the existing implementation of CRM fails to get the accurate data for building an efficient CRM. Data and analysis of data is the major building block for any CRM implementation. Some of the attributes that cause passenger switching are intangible. The technologies like Artificial intelligence & Internet of things has gained lot of prominence in the current decade due to their ability to gather and process huge amount of data. With its data handling and data communication capabilities, Artificial Intelligence (AI) and Internet of Things (IOT) are the ideal candidates for improvement in areas where passengers look for satisfaction. **Table 3**



shows the scope of AI & IOT in retaining the customer for airline along with the suggested improvements in each of the key areas.

Table 3: Brief Scope of AI & IOT for CRM

Factor	Enabling Technology	Scope of Emerging Technology
Baggage Handling	IOT	<p>Baggage handling is concern for most of the passengers and most airlines use simple barcodes for baggage handling. Barcodes are cheap, simple and proven technology but require line-of-sight reading by barcode scanners. To reduce the number of lost or delayed baggage, airlines have to comply with IATA Resolution 753, which requires change of technology.</p> <p>Radio Frequency Identification (RFID) tags is an application evolved from the internet of things concept. RFIDs are small electronic chips that can store &amp; transmit the data about the baggage. Handling of baggage can be easily done with low cost RFID tags [17]. The tags can provide real time information of the baggage and it can be easily tracked This information can be provided to the smart mobiles carried by passengers as desired by majority of passengers surveyed. Switching to conventional baggage tagging to RFID baggage tagging can result in customer satisfaction and retention.</p> <p>RFID tagging can also provide information to the airlines to identify and off-load the specific bags in case the passenger is denied boarding or offloaded before flight. In many cases, the delay in off loading bags has resulted in delay to the flight and losses to airlines. This can improve the operating efficiency of the airline. The cost of implementation for airlines is around US\$ 0.1 per passenger, with cost savings of US\$ 0.2 per passenger. The change of technology is beneficial for the airports too with improvement in parameters like time for arrival of bags, number of bags handled and decrease in baggage mishandling rate.</p>
In flight Entertainment	IOT	<p>IOT concepts can be very useful in providing appropriate in-flight entertainment to the passengers. Personal choice of the passenger like films, serials etc can be found from previous history of the passenger. The in-flight view history of a passenger can be collected by small storage devices in IFE which can be mapped to the particular passenger. There can be a central storage of movies and entertainment in the flight, which the cabin crew can load to the IFE of the passenger with connected IFEs.</p>
Choice of food	AI	<p>Choice of food is highly dependent on person to person, but there can be clues about it food choice from personal information like age, gender and nationality. The typical food usage pattern in a route, the quantity of food wasted etc can be used as inputs to AI. Artificial intelligence algorithms can be used to predict the food options to be provided based on the details of the travelers, which can reduce the quantity of food wasted</p>

Factor	Enabling Technology	Scope of Emerging Technology
		and provide each customer the food of his choice. This will allow airlines to reduce the catering expenditure and keep the flyers happy.
Special Attention to Kids	IOT	Information about kids travelling has to be handled carefully. The IFE contents in the case have to be interactive games and contents that kids like to watch. This can be done by the connected IFE concept & IOT.
Comfort of seats	IOT	Sensors can be fitted on aircraft seats to gather data about the performance of the seats. It can identify occupancy status of seats, the number of times the seat is reclined, the number of times tray table is used and the seatbelt status. An uncomfortable passenger will be moving in the seat and cabin crew can provide special attention to the passenger based on the data from the sensors. The airline can also identify that a seat has lost its comfort and refurbish it based on the sensor data [18]. The cabin crew also will have reduced workload as they do not have to instruct and inspect each passenger about seatbelts.
Type of aircraft	AI	AI technologies can be used to find out the type of aircraft that has to be used on the route. Profile of the passengers can be analyzed using AI technologies. A route like Trivandrum-Dubai consists of majority on middle class working people and cost is the most important criteria for these passengers. Providing a slightly older aircraft on the route will not affect the revenues. The passengers on a route like Bangalore-Dubai mostly consist of mostly software professionals who are careful about the aircraft amenities. Providing an old aircraft on the route can result in passenger switching the airline. Passenger profiling can be regularly done using AI technologies for optimal use of the aircrafts in the fleet.
Reliability & Dependability of the airlines	AI	Unscheduled maintenance is a major concern for all airlines and these results in delays and trip cancellations. The unscheduled maintenance can be avoided with the use of predictive maintenance. This can be implemented using AI techniques and can predict the failure of a component before actual failure. This can reduce unscheduled maintenance and delays to a large extent and improve the reliability of the airlines.
Special care for old aged/sick and disabled passengers	AI & IOT	AI & IOT can play an important role in providing comfortable travel to these classes of passengers. Motorized cars using AI & IOT which can carry two passengers can be used in airport for seamless travel. These vehicles can be parked at designated parking lots at the airports and the passengers can scan their tickets to get boarding pass on the dedicated facility built in on the vehicle without waiting at the normal check in counters. AI techniques can be used to automate the vehicles and move them through the airport with minimum human assistance.
Safety Measures	AI	The cleaning and sanitation of the cabin is currently a human intensive process. AI powered ultra violet technology based cleaning robots can be used by airlines

Factor	Enabling Technology	Scope of Emerging Technology
		for faster and efficient cleaning of the aircraft cabins. This would also reduce the turnaround time for the aircraft and improve the operational efficiency. Additionally AI based thermal body scanners can be used by airlines to check the health status of the passengers before boarding the flight. Machine learning algorithms can be used to predict the symptoms of covid, based on the images from the thermal scanners.

With introduction of emerging technologies in data collection and processing, the factors that cause dissatisfaction to the customer can be reduced to a large extent. This can result in better customer pleasure and better customer retention for sustained revenues. Data will be continuously available for the airlines, which can continuously improve its processes. The privacy issues related to data can be a constraint in some of these proposed improvements. The terms and conditions of data collection and sharing of passenger data and its usage for various activities have to be evolved and this can be included in the terms and conditions of travel. Some of these initiatives like baggage handling require co ordination with the airport to attain full efficiency of the system. Some initiatives like in-flight entertainment, choice of food are completely under the control of the airline. Each of these initiatives have efforts required for implementation which has to take care of factors like cost of implementation, technology readiness level of the systems, co ordination with stakeholders like airport, regulatory approvals for use of technology and constraints on the operations. The impact on CRM from of each of initiatives also will be different based on factors like revenues generated, customer satisfaction, efficiency in operations and customer retention. Based on these factors the relative efforts for implementing each of these technologies and their impact on CRM were evaluated. The relative impact on CRM and the effort for implementation for these are provided in Figure 4.

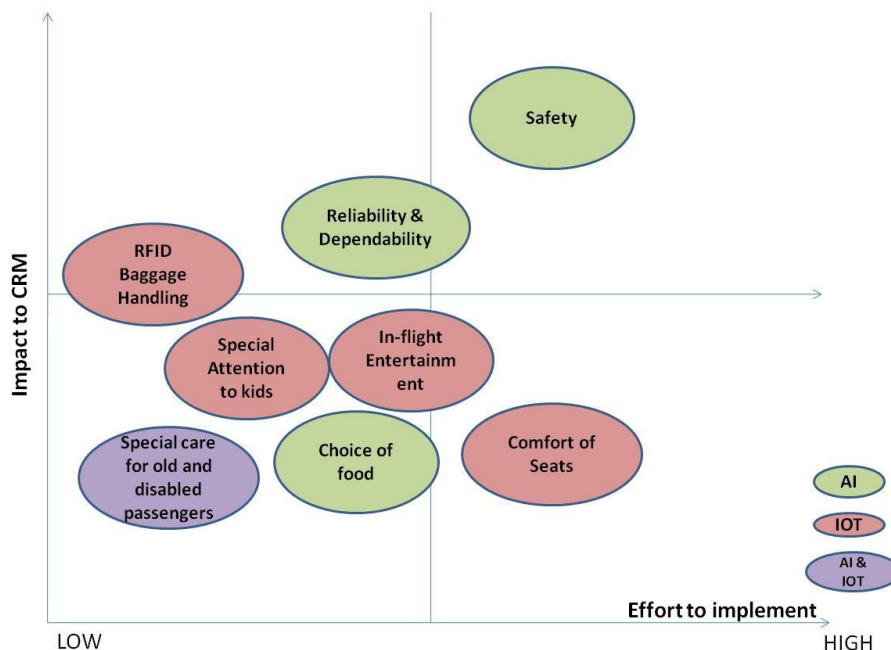


Figure 4: Impact to CRM& effort in Implementation

## 7. Identification of high value customers

Another area in CRM which requires attention is identification of a high value customer. A person who does multiple journeys in a year can be treated as a high value customer. The more number of journeys the person does, the customer becomes more valued and the airlines have to ensure the customer is retained. But as suggested by travel history mentioned in para 2, it is difficult to understand the number of journeys a person does, in case the journeys are performed by multiple airlines and in case the booking is done through different booking channels. An airport enabled with smart technologies can act as a data collection point which can be the baseline for CRM implementation.

An airport traditionally acts the arrival and departure point for the passengers for their air travel. But, an airport can play an important role in analyzing the customer behavior as it is the gateway of a passenger to the system. A passenger will mostly begin the journeys from airport of his home town. Whatever mode a ticket is booked or whichever airline the passenger select, the passenger ultimately travels through the airport and passes through the mandatory check points in the airport. To clearly identify how many times a person travels by air, the best available option is the airport of his home town. Face recognition techniques can be implemented at the airports at security check points. A face recognition system at airport can be useful in identifying a frequent flyer and generating lot of data for CRM activities. The images of the passengers taken from the airport security can be a reliable source of how many times a person travels.

This can serve two purposes:

- Quick identification of passengers using the face recognition techniques and reduce the time in travel procedures like verification of documents. This will improve the efficiency of the airport operations.
- Create a database for travel history of passengers, which can be used for identifying the high value passengers or the frequent travelers. The second point can be the input for many of the CRM activities for airlines which enable them to decide which the passengers to be retained.

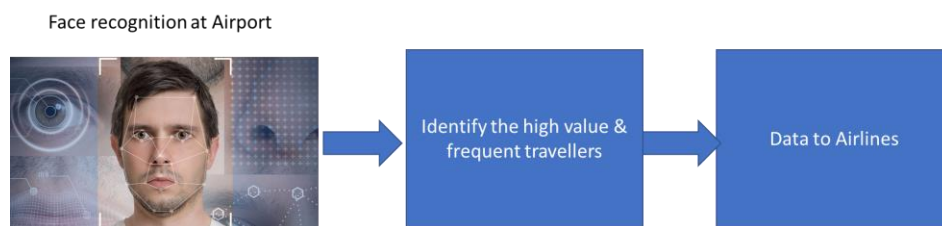


Figure 5: Face Recognition at Airport as a data source for CRM

## 8. Benefits of Data Driven Smart CRM

A new smart CRM implementation plan powered by data has been envisaged based on the studies carried out, which can overcome many of the drawbacks in the existing CRM systems. Implementation of the new CRM scheme benefits airlines, airports and passengers. The specific benefits for each of the stakeholders involved are provided in **Table 4**.

Table 4: Beneficiaries of CRM

Si No	Beneficiary	Benefits
1.	Airline	Existing CRM has drawbacks cannot capture the entire passenger behavior. Data from the airport can assist airlines in clearly identifying the frequent travelers and IOT & AI can assist in identifying what are the areas of concern for the passengers and offer improvement in these areas. Improvement in Customer Relationship Management can result in increase of revenues by customer retention. The proper use of CRM tools can ensure that the resources are planned and utilized in the optimum way. Providing a more personalized travel experience would make many customers spend little more on air travel which can be very critical in sustainability of the airlines.
2.	Airport	Implementation of face recognition techniques in airports offers dual benefits to airports. The techniques can assist in contactless and fast movement of passengers during the check-in & departure process. This can improve the number of passengers travelling through the airport and increase in revenues. Additional revenues can be obtained from providing data to the airlines for their Customer Relationship Management activities. The technologies like RFIDs in baggage handling can improve the efficiency of the airports. The implementation of features for disabled passengers can improve the goodwill factor of the airports along with airlines. Safety features like AI based thermal scanners installed at airports will increase the confidence of many passengers, who are afraid that they are sharing an aircraft with an infected passenger.
3.	Passenger	Reduction in time spent for activities like check-in procedures and security checks will be beneficial for the passenger. A personalized experience for the passenger in flight leads to customer satisfaction and customer delight. It can prompt passenger to spent little more money on air travel.

## 9. Conclusion

The aviation industry in the world has seen unforeseen turbulences in the recent times. Many low cost airlines have stopped operations and full service carriers are struggling with huge losses. Retaining the profitable customer is of critical importance in aviation under the current circumstances. Investments have to be made on data and data driven technologies for sustained revenues in the future. Safety of travel is a major concern for all passengers and use of technology to ensure safer cabins is a requirement for all airlines. Full service carriers have to invest in AI & IOT to enhance the customer experience and product differentiation to retain the customers. Investment in AI and IoT is required even for low cost carriers to reduce the losses due to delays and improve the operational efficiency. The new smart CRM implementation is a win-win situation for both airlines and airports.

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