Aneesh Nair

Digitized Solutions for Aviation Industry

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SEINÄJOEN AMMATTIKORKEAKOULU

SEINÄJOKI UNIVERSITY OF APPLIED SCIENCES

Thesis abstract

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Author(s): Aneesh Nair

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This thesis focuses on the solutions and the advantages of making ground handling and airports digitized, through digitized solutions. Providing ease of operations and cost effectiveness.

Aviation industry is a rapidly growing sector giving millions of people a source of income. By the increasing work force, there's a huge amount of errors that's occurring in the day to day operations. The aim of this thesis is to prove how these solutions can change the way of working and operations in the aviation sector. Advantages of these systems will be analysed, and a practical conclusion will be made.

For the collection of this study's research data, various professionals and consultants from the aviation industry was interviewed during presentation and conference phase from around the globe and a small session of data collection was also conducted among the employees working behind and along with these systems. These professionals included individuals with their expertise in ground handling industries, aviation consulting firms and airport organizations.

This data opened up number of needs and benefits revealing improvement of planning accuracy through simulation, organizational reactiveness, establishing the errors using real time monitoring. It also revealed a huge demand for these systems.

The timeline of this thesis begins from February 2020 and concluded in November 2020

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1 Introduction

This thesis focuses on the study of digitalized solutions that's been used or are in the stages of being implemented in the airports/airlines/ground handling industry. As of now, only few aviation companies around the world has implemented these systems into their daily operations as in the coming years the aviation capacity is going to take a whole new level which will lead to an increase in the operations. Every companies main goal is to conduct these operations in an efficient and cost effective manner, in that case the main objective of this study is to find out how the companies are going to value from these systems and how it's going to change the aviation industry in whole.

The first topic that we are going to cover in this theoritical study is the growth of the aviation sector. Number of increase in the passengers, job growth and possible AI technologies that are being introduced in the industry. We will take a look into the world aviation market as well as Finnish aviation industry and Indian aviation industry (which is set to takeover the U.S aviation market in coming years with it's predicted course of reaching one billion flights per year).

The second topic that we are going to cover and analyze is based on the digitalized solutions that are being used by the aviation companies to smoothen their operations and their results. We will go into three main modules used by the industry which will be as followed resource management system, billing management system and aircraft turnaround management.

The third and final theoritical part will be focusing mainly on the air cargo industry as "why digitization is the only way out for air cargo industry". We will also analyze some potential digitized system for the cargo industry as well.

In the end, the study will be followed by a methodology of primary data collected through interviews, presentations and conference that were organized within the aviation industry professionals to get a deep understanding of this solutions. As of my analysis that I have done on this topic, there are no fully analyzed research that has been done on this case, and with a working experience in this industry

and being able to develop a broad knowledge on this topic, I would like to contribute my part by doing this research in a full detailed manner.

2. Air Travel Growth

The rate by which air travel is growing, it is on a growing set of path which is expected to double over the 20 years. As of now only 20 % of the world population has set their foot onto air travel, which is rapidly growing year by year. This growth will generate many more routes, airports, planes, pilots and many more. According to International Air Transport Association (IATA/NationalGeographic) forecast the number of passengers that are expected to choose air travel as their choice will reach 8.2 billion in 2037, which is almost 400 million more passengers that are expected to travek by air in the 2036. This data was based on a 3.5 % of compound annual growth rate of the aviation industry. One of the most influential growing market at this point of time is the Indian aviation market. (IATA, 2017)

With the growing demand for the airlines, there are many other steps being taken to improve the cost and the efficieny of the operations. Along with to cutting down the CO_2 emission. Every sector of this industry is working towards improving the air travel as the demand grows more and more. (European Commission)

From 1st of January 2019 mandotary emission reporting has become part of the aviation industry which was under the Carbon offsetting and reduction scheme for International aviation (CORSIA), which was put in place to cut down the CO_2 emission in half by 2050. (IATA, 2017)

Airports and airlines are investing heavily on upgrading their passenger travel experience by implementing technologies like Biometric ID scanning, automated check-in and baggage drops, improvement in security scanning systems and digital based services for passengers.(Airport Technology) With that they are also investing into technologies to imporve their effeciency of their operations by adopting systems like resource management solutions, billing solutions and aircraft turn around management. These are few solutions used by the ground handlers and the airports to improve their ground effeciencies. (FTE)

The growth rate that we are seeing right now, the industry is expected to go complete AI and improved technologies in the coming few years.

2.1 "Asia" The Hub of Popular Flights

As China dominating the aviation market by becoming first trillion dollar market, India is catching up with fast with the chinese aviation market. According to boeing projects the demand for the aircrafts will surpass 39,000 in next 20 years out of which 15,000 will be directed to the asian aviation market. The main reason for this huge demand and expansion is due to the rising income level and the developing economies within the asian countries. (IATA, 2017)

According to a analysis made by the IATA in 2016, the aviaiton market by 2036 in India is expected to grow 227% followed by China 166% and Indonesia 134%. A projected regional growth of 3.1 from 1.3 billion passengers keeps Asia as a leading aviation market as well. (NationalGeographic/IATA, 2017) As the covid has slowed down the growth to an extent in 2020, it is expected that the aviation market growth will get back on it's normal path instantly. Even though the lifestyle of travelling will be completely transformed but people wont "stop flying".

Figure 1. The worlds most popular flights (2016). (National Geographic/Beth Redpath, 2017)

With the growing demand for the air travel, number of asian international airports are investing heavily into technologies. Changi and Hong-Kong international

airports have begin testing their biometric project that will change the passenger experiences in the coming years. Bengaluru international airport which is India's third most biggest airport is also sharing their contribution towards the biometric tech world to support its growth. Asian airports are also leading in terms of implementation of robotics and AI technologies within the airports and airlines. A few of these groundbreaking technology can be seen at the Incheon Airport. (FTE, 2020)

When it comes to digitization in the operations of the ground handling companies, many GH companies around the asian continent has already equipped the cloud based technology including Malaysia, Phillipines, India, China, Indonesia and many more. Rsmart is one of those unique company which offers the cloud based services to the ground handlers, airports and airlines through a subscription based plan. More about this company background and it's solutions offered to ground handlers/airports/airlines will be explained later in the this study.(Rsmart)

2.2 Indian Aviation Market

As an upcoming trillion dollar aviation market forecasted by many aviation experts and channels and a main rivalry for the chinese market, India is ready to take on the world in the aviation sector. (IATA)

India is now considered the third largest aviaiton market in terms of domestic ticket sales and one of the fastest growing. Indian aviation comprises of 91 international carriers including 5 Indian carriers. In 2018 the revenue per kilometer in Indian market demand growth was at a staggering 18.6 % which was three times the global revenue per kilometer of 6.5 %. There are few forecasts made for the aviaiton market in India which includes the Indian carriers increasing their fleet size to 1100 aircrafts by 2027, Freight traffic to rise around 11..4 MT by 2032, It is also considered as the second fastest growing country in terms of passenger traffic by the Airports Council International (AIC) between 2017-2040. Presently the Indian aviaiton sector contributes around 72 billion dollars to it's economy, which is rapidly growing day by day. (InvestIndia/IATA)

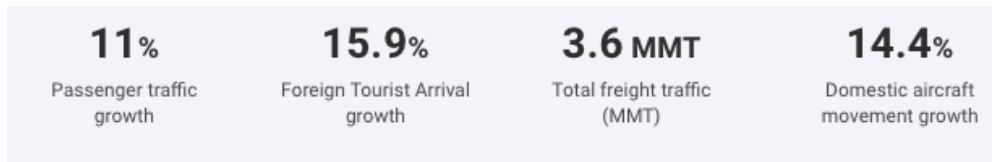| 11%	15.9%	3.6 MMT	14.4%
Passenger traffic growth	Foreign Tourist Arrival growth	Total freight traffic (MMT)	Domestic aircraft movement growth

Figure 2. Current Indian aviation growth chart. (InvestIndia, 2020)

India was also named as the fastest growing aviation by IATA for the fourth consecutive Year. (TimesofIndia, 2019)

When it comes to ground service operations, it's growing with the same pace as of any airlines or airport capacity. Ground handling industry in India is one of the most challenging industry in the aviation sector, Indian airports always prefers the most qualified ground support for their ecosystem. The market share in the ground handling sector is already occupied by the big players like Celebi, Menzies Aviation and Air India SATS. (TSG/Sunday Guardian Live, 2019)

As of now Air India SATS is using few many of Rsmart's digital solutions to smoothen their operations. Below shown is a case study that was made on the Air India SATS according to the business needs and the final outcome after the use of Rsmart's digitized solutions. (Rsmart)

Business need	Solution	Client outcome
• Client wanted to move away from manual turnaround business processes • Automatic rostering of employee task assignment • To enable employees to opt for overtime based on the local labour laws • Reduce operation cost and increase in employee efficiency • Revenue leakage from ancillary services performed over and above the standard SGHA turnaround. • No visibility and capability to tracks SLA	• An API integration with the airlines PTS to capture the schedule of activities • Implemented automatic roster planning and day of operations functionality to plan and monitor the turnaround activities • Onboarded all the ground handling staff with our mobile application • Integrated with their ERP to BMS to ensure all the invoices are generated • A real time event monitoring for flight schedule • Reporting and Dashboard for supervisors to monitor the operations	• Skill management and automatic rostering of 10,000 employees on a daily basis • Utilising the solution for 180,000 turnarounds per year • Increased revenue by capturing and invoicing of additional services provided to airlines • Workforce efficiency of around 12% post implementation of the solution.

Table 1. Case study on Air India SATS. (Rsmart/Unpublished Company Materials, 2020)

2.3 Finnish Aviation Market

According to Finavia, passenger volumes grew upto 10.1 % in 2018 as compared to 2017 and the volumes at Helsinki airport surpassed 20 million passengers for the first time in the Finnish aviation history. (Finavia, 2019)

Many airlines companies has been showing a keen interest in the Finnish aviation market, with making valuable investments. The Danish air transport in 2018 aquired a 60 % stake in the Nordic regional airlines. Increase in flight frequencies and improved connections has been made in the region. (Aviation Business News)

Aviation academy has been set up recently in Aviapolis, Vantaa. Aviapolis is one of the most developing business hub of Finland. The main goal of this academy is to gain an international recoginition as an institution and future mobility. During my internship in Rsmart I had a chance to visit this academy as my company and the academy were doing a collaboration to find some candidates for our company. There are several such small institutions or agencies that has been set to grow the Finnish aviation and it's future goals. (BusinessVantaa, 2019)

As per the Finnish ground handling companies, there are few big players in the sector such as Airpro, Aviator and Swissport. The amazing thing that author noticed during working in the Finnish aviation industry is that, Airpro which is a Finnish found company is dominating the ground support industry were like in India it's been controlled by foreign powers. Finnish aviation industry always "prefers their local business first and rest later" which is a good thing in author's opinion, helps growing local businesses.

Finnish ground support companies does use some digitalized solutions, Aviator being one of them. Aviator uses solutions from a company known as Damarel which is a similar company like Rsmart, providing the industry with digitized solutions. But the main concern that they are facing at this point is that the Damarel systems are very complex and slow, and they were really keened towards trying out a system like Rsmart, due to it's easiness to follow up, smooth interface and being also available on a normal smartphone to be used by the employees. Rsmart was considered as one of the best alternative for Damarel by the Aviator. (Rsmart/Unpublished Company Materials, 2020)

3. Analysis of Digitized Solutions

There are many solutions that are essential for the airports, airlines and the groundhandling companies other than the mainstream biometrics upgrade or turning the whole eco system into AI and robotics. These solutions also play a major role in the digitization of the aviation industry as making the operations efficient and cost effective are the main goals of these systems. I had a great oppurtunity to see these systems in detailed action and notice how complex these operations can get without these systems in place. Airport operations are not exactly as same as we think, many resources and time goes into play to execute these operations in a right and systematic way. One error can break the chain of the operation and cost these companies millions of dollars. These systems also ensure the reduction in errors and making it more reliable for the companies. (FTE)
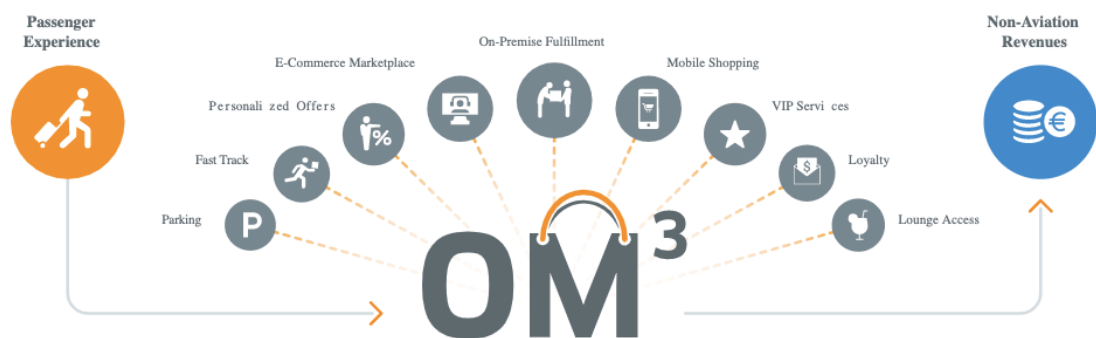
Figure 3. OM3 Digital solutions for airport. (AOE)

The above picture shows how passengers can plan their travel, do e-shopping online or offline at the airport and access airport services like lounge and etc. (AOE)

These facilities would be much better if it can be accessable from the passengers smartphone itself. Everything put together under one cloud system.

According to Marius Gežinis (CEO of Lithuania Airport) airports should be competitive and they can improve their operations by either expanding the airport or by implementing digitized solutions or they can go for both the ways. (Passenget Terminal Today, 2019)

If you expand the airport, the operations are going to expand by themselves. In that case digitization is a must to run those operations smoothly, without any kind of interuptions or human errors.

3.1 Rsmart Software OY Company Profile

Rsmart is a India and Finland based company specialising in providing digitized solutions for the aviaiton industry. With their main headquarters in both India and Finland, they are one of the major players of their industry, their systems have been implemented in more than 27 airports at this point of time and they are growing at fast pace. Solutions provided by Rsmart includes Resource Management System (RMS), Billing Management System (BMS), Aircraft Turnaround Management (ATM), Lounge Management System (LMS), Equipment Maintainence Systme (EMS) and PRM Handling. (Rsmart) Below we are going to focus deeply on 3 of the most important modules of Rsmart that is RMS, BMS and ATM. (Rsmart)

The information provided about the Rsmart solutions below has been taken from unpublished company tender documents, first of which the Rsmart Functional Unpublished tender material which was authored by (Aneesh Nair, Finland and Vardharajan Chellapa, India) and the second document which has been used is a collaborative tender between DXC and Rsmart authored by (Aneesh Nair (Rsmart), Finland and Deepak Patil (DXC) London).

3.2 Resource Management Solutions

Resource management system allows you to plan your resources, schedule your rsoter according to the airlines requirment and real time deployment of the resources. (Rsmart)

RMS is one of the speciality of Rsmart as R of Rsmart stands for Resource and is one of the most used module from the company. (Rsmart)

Rsmart RMS has it's core a dynamic on the day of operation deployment capability.However perfectly a handler may plan their day of operation according to human resources, we know only too well that there is seldom. If ever a day that

does not contain changes foreseen and unforeseen. On the day, dynamic deployment enables management intervention to manage changes – late or absent staff, Illness during a shift, early arriving and late departing flights, changes of load, return to gate, additional towing, unexpected use of remote stands, the list is endless and these things can happen every day. With RMS, the management of the companies will have complete transparency and bility to move staff from one assignment to the another one. As well as relocating tasks, additional staff with relevant skills can be called from rest periods into work according to the local law standards or are allowed to leave early. Overtime can be approved or declined and all within the context of understanding SLA agreed with the individual airlines. (Rsmart/Functional Unpublished Company Materials)

The mobile activision of the system is highly efficient in this on the day deployment and enables staff between tasks to be allocated new tasks, additional staff allocated to deal with unexpected situations such as unexpected baggage loads or overload of passengers at the check in booth. Whatever the situation is the day deployment can improve quality, assist the achievement of SLA's and help control cost of labour and always observing such agreements as minimum rest periods, annualized hours and much more. RMS is a dynamic tool at the fingertips of the management enabling absolute focus on quality and SLA at optimum costs and always overseeing all the labour agreements in place. (Rsmart/Functional Unpublished Company Materials)
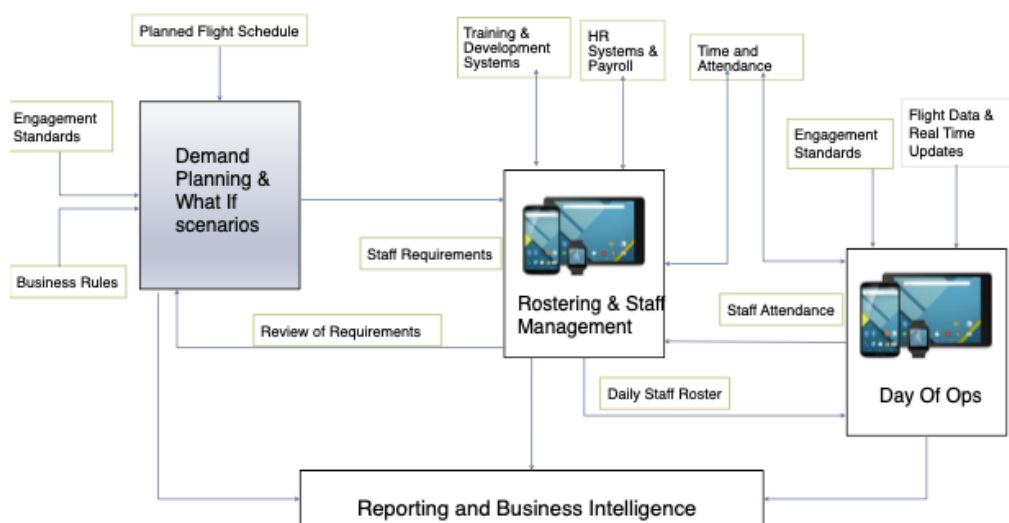

Figure 4. Rsmart RMS – Process Overview. (Rsmart/Functional Unpublished Company Materials)

Resource management is system is highly important for the aviation industry as it helps to use their resources and equipment's more efficiently with a better executed planning and best assignments of the resources. (TAV Technologies)

3.2.1 Interface with Human Resource Management System (Rsmart/Fucntional Unpublished Company Materials)

- For Staff names and codes

- Staff Designation

- Training and certification details

- Skills sets details

- Staff availability

    1. Interface with the leave management system.

    2. With the attendance management system.

    3. Bio-metric devices for the real time availability of the staff.

    4. Always considering all labour laws and agreements and any annualized hours considerations.

    5. Always with dynamic on the day deployment transparency for management intervention and ability to react dynamically to changing circumstances.

3.2.2 Complying Service Level Agreement

For agreed employees services levels (SLA) according to aircraft type, mode of operations and the body type of an airline. All types of rules and parameters that are airline specific or airport specific defined in the SLA module are integrated with the resource planning program to derive the roster plan that places the right staff with right skills are allocated the tasks effeciently. (Rsmart/Functional Unpublished Company Materials)

3.2.3 Flight Information System

Information Systems for the flight timings and information related to any cancellations or delay, type of change etc. This information is fetched from airport flight information system or any existing ground handler's operations management systems. (Rsmart/Functional Unpublished Company Materials)

3.2.4 Messaging Systems

This feature interfaces with the mail servers and SMS gateways for intanst contact between the supervisiors and the employees for mails and messages in case of any sudden deployement changes and situations. (Rsmart/Functional Unpublished Company Materials)

3.2.5 RMS – The Process (Rsmart/Functional Unpublished Company Materials)

- System picks up the flight schedule for selected period

- Checks the contract and SLA for services according to the Aircraft type, mode of operation and body type.

- Checks the required skill set for required services for each flight.

- Auto allocates staff and flight according to skill sets required for services, after considering contract and SLA and other parameters.

- Allows the user to edit/modify according to the need.

- Displays the allocation to the users with excess or shortage of resources if any, for manual adjustments.

- Works based on the shift and roster plans available in the system respecting all labour agreements.

- Based on this information management have an override capability when necessary.

- Split shift and block hours / day are handled in DRP.

- Complient with IATA/ICAO with industry standards.

3.2.6 Real time deployment (RTD)

RTD helps management to make dynamic on the day adjustments based on the day to day real time needs and changes in needs of the ground handler's operations. It completely synergies the real-time situations such as early arrivals delayed departures, cancellations, ad-hoc flights and additional, absentees/no-shows, customer demands and so on. It helps the managers to deploy, re-deploy resources and helps them to plan, allot and approve/ decline over-time effectively. (Rsmart/Functional Unpublished Company Materials)

- For a given date, the system displays the flights that are to be handled with the planned allocation details.

- Clean and easy dashboard for the management to monitor who is doing what for every flight of the day.

- On selection of a specific flight all labor details can be identified instantly enabling management intervention as required. This can be very useful for example a VVIP is on-board an arriving or departing flight and you want to make special arrangements for embarking/disembarking or security matters and so on.

- Auto allocation in case of any changes in ATA/ATD or ETA/ETD, aircraft changes or any special requests.

3.2.7 RMS Features (Rsmart/Functional Unpublished Company Materials)

- Roster and SLA configuration

- Employees skill set management (allows to record employees special dedicated skills)

- Employee training details including any currency

- Roster rules

- Daily allocation plan

- Weekly allocation plan

- Duty change/Duty swap (if allowed)

- Mobile app for staff alert and notification

- Roster planning

- Flight movement based roster planning

- What if analysis

- Globally accessible

- Roster analysis

    1. By period

    2. Airline

    3. Flights

    4. Team

    5. Department

- Real time deployment

- Daily deployment

- Auto allocation

    1. Load change

    2. Aircraft type change

    3. Delay

4. Cancellation

- Real time Optimum Auto deployment

- Flight based deployment report

- System is highly customizable according to the company or airport requirements

- Mobile interface to all staff

With resource management system airports/ground handlers/airlines can make sure that their resources are being used efficiently, with low unit costs and guaranteed high profit margin. Without a proper resource management passenger travel experience could also take a hit. These digitized solutions make sure that the companies efficiently use their resources. (Zsolt Kelemen, 2004, 24)

3.2.8 Availability Management

The availability management module will support functionally for employees to mark themselves available or not available for the rostering tasks. The component will have a business logic to enable users to set the hours for each shift or for a day in the near future based on their availability. The availability can also be automatically updated by the system if an interface is available to HR system to access the leave management data. (Rsmart and DXC/ Unpublished Tender Material)

- **Leave Management**

The employees/agents can apply for leaves using their mobile application which will ensure that they are not considered for rostering for that day. (Rsmart and DXC/ Unpublished Tender Material)

The main reason that this application is considered important in variety of organizations including aviation industry is that it eliminates the paperwork, no need of manual intervention, improves overall communication, ensures legal compliance and a real-time visible data. (Kissflow)
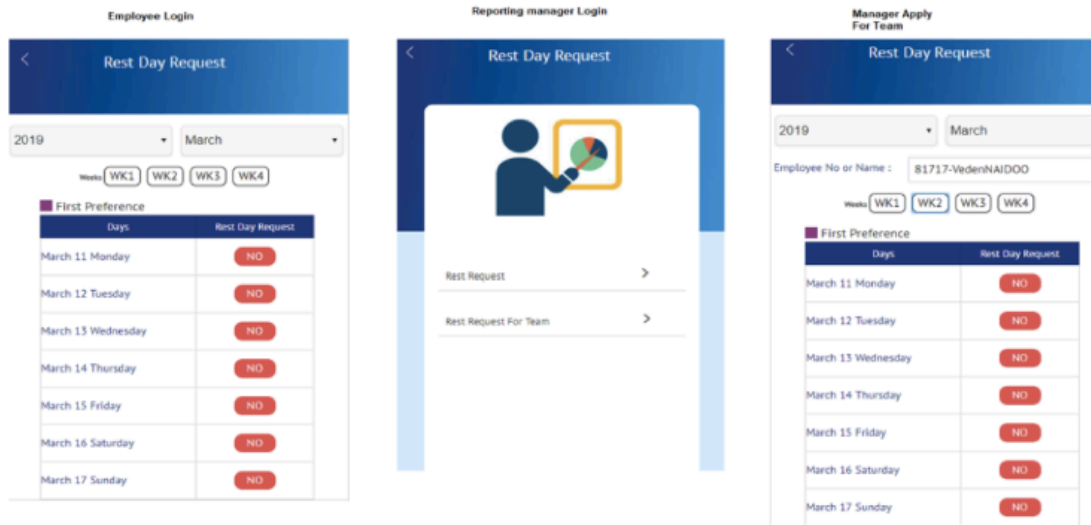
Figure 5. Rest Management. (Rsmart and DXC/ Unpublished Tender Material)

- **Training**

  The employees have a feature to mark themselves as unavailable to rostering due to their planned training sessions. These requests will be sent for the managers and once approved will be marked for unavailability. (Rsmart and DXC/ Unpublished Tender Material)
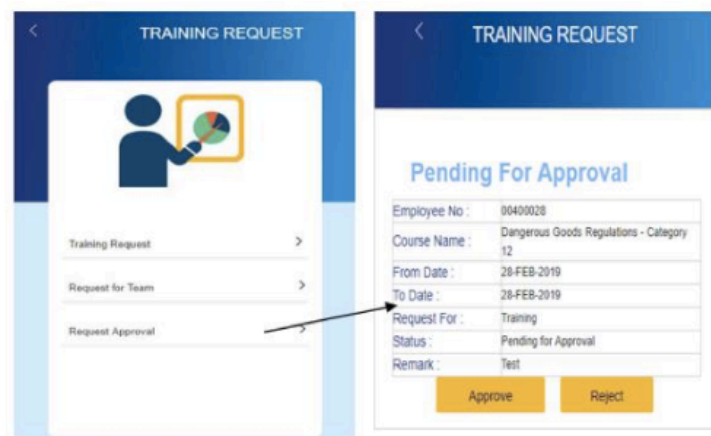

Figure 6. Training Module. (Rsmart and DXC/ Unpublished Tender Material)

3.3 Billing Management System

Managing Billing information's at the airport is considered as one of the most complex due to very tough billing instructions and formulas. And can have some changes depending on the airlines and airports which makes it really difficult to handle manually using Excel spreadsheets. (Amar Infotech)

Billing management allows you to record all your GSP contracts with the ability of showing the date and time when the contract was made. With the help of mobile app, it can also get the team approvals without being physically present at the site, which makes it much efficient and less time consuming. It also gives alerts, escalations and deviations complete capturing of data for the SLA tracking. The billing process if considered to be one of the most complex process of the aviation industry making disputes and payment delays between the customers and companies, with the help of billing management solution you can bill much accurately and on time. It also gives you the opportunity to providing valuable knowledge of the services provided. (Rsmart)
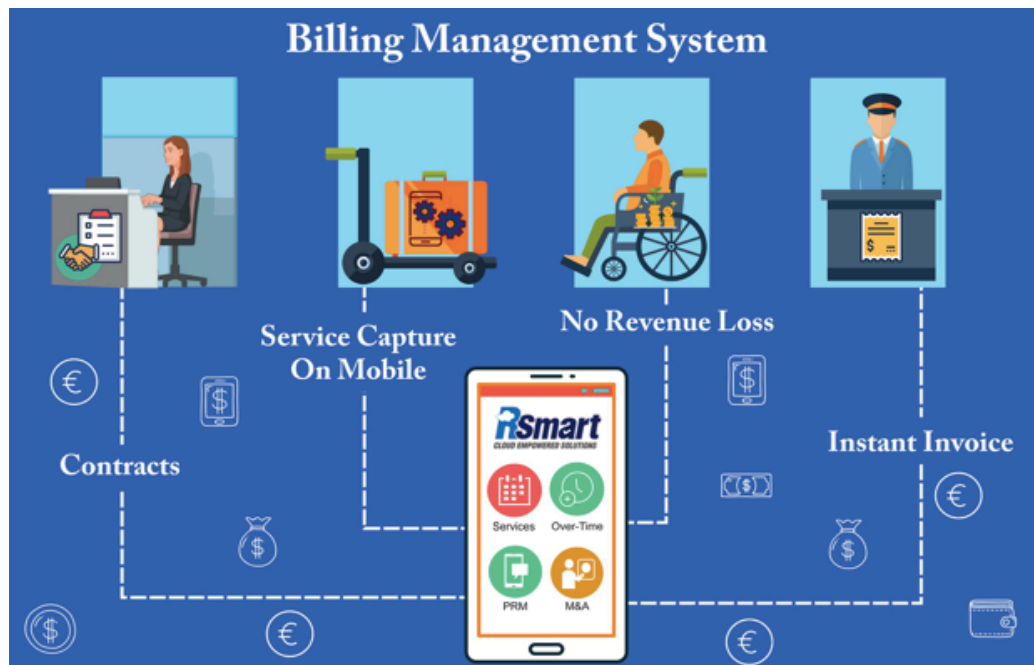

Figure 7. Billing Management System Overview. (Rsmart Unpublished Functional Material)

3.3.1 Cost Setup

The system allows the management of the cost for each of the tasks. As part of the solution we can have a contract setup for all the tasks with each contract you can associate cost, currency, and the contract period. Each task can have multiple contract period so that any changes to the terms and conditions can be tracked with a different contract. (Rsmart and DXC/ Unpublished Tender Material)

Figure 8. Cost Setup. (Rsmart and DXC/ Unpublished Tender Material)

3.3.2 Invoice Management

The solution has an in-built module which will generate invoices based on the services provided as part of the tasks for other airlines. The solution will automatically generate an invoice per flight based on the services provided by the ground handling team. The costs associated with each task will be based on the contract setup for the tasks. The invoice is aligned to the IATA approved standards. (Rsmart and DXC/ Unpublished Tender Material)

Below mentioned is a sample IATA standard invoice that is used around the aviation industry for the standard billing purpose.

Figure 9. Sample IATA standard invoice. (Rsmart and DXC/ Unpublished Tender Material)

3.2.3 Audit Trails

The system captures the audit trail of all the changes performed by the users across all the functionalities within the application. Most of the setup screens the audit trail is available on the screen with the creation date, created by, modified date and modified by. Some of the transactions screens have all the audit trail generated using the report on all the changes done to the data. This report will provide the details such as the field name, old value, new value, created date, created by, modified by and modified date. (Rsmart and DXC/ Unpublished Tender Material)

The aviation industry has been putting all their R&D towards the ultimate race to becoming carbon neutral. Recently London's heathrow airport was awarded with the Level 3+ Neutrality status for it's commitment towards becoming carbon neutral. (Airport Technocology, 2020)

3.4 Aircraft Turnaround Management

Aircraft turnaround system is also one of the Rsmart's center piece as it gives airport a lot of digitized authority, the solution caters to both the control center to manage the work allocation, monitionring of turnaroudn activities and mobile aplication for ground handling services team to perform their day to day turnaround activities. (Rsmart and DXC/ Unpublished Tender Material)

Figure 10. Aircraft Turnaround Management. (Rsmart)

There are few similar companies providing the same module for example INFORM Gmbh, but from what I have learned from my experience is that the following systems are not cheap and are not as detailed as the module provided by Rsmart.

3.4.1 Flight precision time schedule (PTS) Interface

The turnaround management platform can be integrated with the clients precision time schedule data to fetch the aircraft schedule for all the future flights to be handled by the system. The system supports both an API interface to inject data on a regular interval/event or batch processing to receive the flight schedule data

on a regular basis. Each flight will have it's precision time schedule information along with the below mentioned. (Rsmart and DXC/ Unpublished Tender Material)

- Airline Name

- Service Name

- Aircraft Type

- Aircraft Model

- Flight Number

- Mode of Operation

- Block Arrival date and time

- Each turnaround activity expected start date and time

- Each turnaround activity expected end date and time

- Off block date and time

3.4.2 Engagement Standard

The Engagement standard module of the turnaround management platform enables users to manage predefinded template for all turnaround activities required for a type of airline/aircraft/service combination. (Rsmart and DXC/ Unpublished Tender Material)

Once the data has been configured, the same engagement standards can be applied to the flight data that is derived from the precision time schedule data which provides a detailed view of the scheduled and associated tasks for all that flight. (Rsmart and DXC/ Unpublished Tender Material)

The solution is configurable against service name, aircraft type, type of operation and etec. Which will allow airlines to define their business terminology. (Rsmart and DXC/ Unpublished Tender Material)

STANDARD Airline [All ▼] Service [All ▼] Department [All ▼] [Go] [Exit] [Copy From] [UPLOAD] Export to excel

#	AIRLINE NAME	SERVICE NAME	FLIGHT TYPE	MODE OF OPERATION	AIRCRAFT BODY TYPE	FLIGHT CATEGORY	ADD NEW
	AEGEAN AIRLINES	Airside Operations	INTERNATIONAL	DEPARTURE	PROPELLER	PA	Edit Delete
	AEGEAN AIRLINES	Airside Operations	INTERNATIONAL	ARRIVAL	NARROW	PA	Edit Delete
	AEGEAN AIRLINES	Airside Operations	INTERNATIONAL	ARRIVAL	PROPELLER	PA	Edit Delete
	AEGEAN AIRLINES	Airside Operations	INTERNATIONAL	DEPARTURE	NARROW	PA	Edit Delete

RESOURCE TYPE	SKILL SET / EQUIPMENT	AIRCRAFT_TYPE	RESOURCE DEMAND	MALE QUANTITY	FEMALE QUANTITY	START TIME		END TIME				#	ADD NEW
						STA STD	TIME	STA STD	TIME	DURATION	Load Factor		
M	Aircraft Handling Controller			1		Before STD	45	After STD	10		NONE		Delete Edit
M	Aircraft Handling Controller			1		Before STD	45	After STD	5		NONE		Delete Edit
M	Driver - Pushback	320		1		Before STD	5	After STD	10		NONE		Delete Edit
M	Driver - Pushback	321		1		Before STD	5	After STD	10		NONE		Delete Edit
M	Driver - Pushback	319		1		Before STD	5	After STD	10		NONE		Delete Edit
M	Group Leader			1		Before STD	25	After STD	5		NONE		Delete Edit
M	Transport Worker	319		1		Before STD	25	After STD	5		NONE		Delete Edit
M	Transport Worker	321		1		Before STD	25	After STD	5		NONE		Delete Edit
M	Transport Worker	320		1		Before STD	25	After STD	5		NONE		Delete Edit
M	Transport Worker Tractor Driver	319		2		Before STD	25	After STD	5		NONE		Delete Edit

Page 1 of 2 (13 items) [1] 2

Figure 11. Engagement Standard Module. (Rsmart and DXC/ Unpublished Tender Material)

3.4.3 Equipment Module

This is the setup to add all the equipment's that are required to perform the turna-round activity. Each equipment will be mapped to a turnaround activity so that the equipment is booked for the activity. Additionally, the equipment's or aircraft can be made unavailable due to their planned or unplanned maintenance work. There is a feature to mark the planned maintenance work well in advance to ensure that the aircraft/equipment is unavailable for that day. (Rsmart and DXC/ Unpublished Tender Material)

Equipment Name : Bus * Equipment Description : ☑ Active
Equipment Code : Bus Equipment Qty : 14 [Show] ☐ Track In ATM
☐ Exclude From Rostering Allow Manual Allocation Department : --Select-- ▼

New	Equipment Unit #
Edit	Bus-16
Edit	Bus-1
Edit	Bus-2
Edit	Bus-3
Edit	Bus-4
Edit	Bus-5
Edit	Bus-6
Edit	Bus-7
Edit	Bus-8
Edit	Bus-9
Edit	Bus-11
Edit	Bus-12
Edit	Bus-14

[Update] [Exit]

Figure 12. Equipment Module. (Rsmart and DXC/ Unpublished Tender Material)

3.4.4 Real time Auto Allocation – flight delay

The aircraft turnaround management solution allows the automatic allocation to be changed on need basis at any time. The system understands that the practical needs of the airlines to adapt itself due to aircraft delay or delayed turnaround activities may need to change the application on the go and then again auto allocate tasks accordingly. It completely synergies the real-time situations such as early arrivals/late departures, cancellations, additional and ad-hoc flights, absenteeism/no-show, customer demand etc. The solution provides the functionality to do changes on need basis and then do a re-allocate. (Rsmart and DXC/ Unpublished Tender Material)

3.4.5 Manual Allocation

Manual allocation allows the turnaround activates to all the flights scheduled for that day or that moment. The allocation is based on the availability of the resources that are already configured and equipment's availability. The manual allocation can be done for the auto allocated rostering or for an unallocated flight. There is a feature to add ad-hoc flight which is not part of the PTS to be tracked under the turnaround. (Rsmart and DXC/ Unpublished Tender Material)

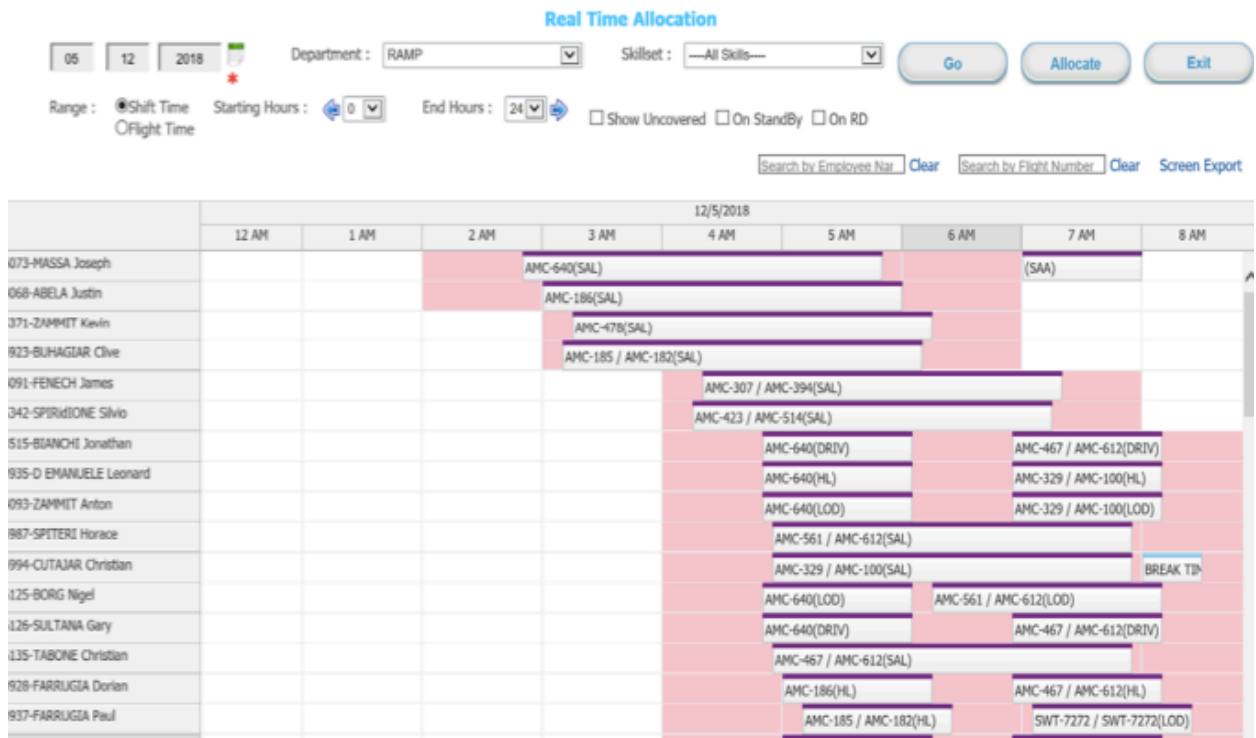Figure 13. Auto Allocation Module. (Rsmart and DXC/ Unpublished Tender Material)

Figure 14. Manual Allocation Module. (Rsmart and DXC/ Unpublished Tender Material)

3.4.6 Roster Anomalies

The aircraft turnaround management solution identifies all the pending tasks that needs equipment or employee association for the tasks to be completed. The anomolies are highlighted in different colours to indicate the status. Each flight is identified to ensure that all the turnaround activities are equipped with right allocation to perform the required tasks. Red indicates some tasks are not assigned and green indicates all the task have been assigned to a respective employee. Additionally, the system provides the court of tasks that are as signed and the court of tasks that needs assignment. The solution has a feature to drill down to each of the flight to identify the task that needs an assignee. Once the tasks have been identified the system provides an option to assign an employee to this task and the assigner will have three option to choose:- (Rsmart and DXC/ Unpublished Tender Material)

- Employees with additional overtime

This list will provide the list of employees who are outside their shift and are either closer to end shift or closer to start of shift.

- Employees on leave

  This list will provide the list of employees who are either on a planned leave or they are on weekly off.

- Employees with overlap task

  This will provide the employees who are already allocated to work on a task on a assigned flight to work on additional overlap task on the same flight.

3.4.7 Modelling and Simulation : What if Analysis

The solution comes with a pre-built simulation and modeling functionality for creating and analyzing a digital prototype of a physical model to predict its performance in the real world. Simulation modelling will help supervisors and managers to understand wheather, under what conditions, and in which ways turnaround process could get delayed and what loads it can withstand.The planning module gives the options to play around with precision time schedule, the employee availability and the flight performance to predict the behaviour of the overall business process performance.The system will help in identifying all the risks and challenges with the change in any of the planned activity. (Rsmart and DXC/ Unpublished Tender Material)
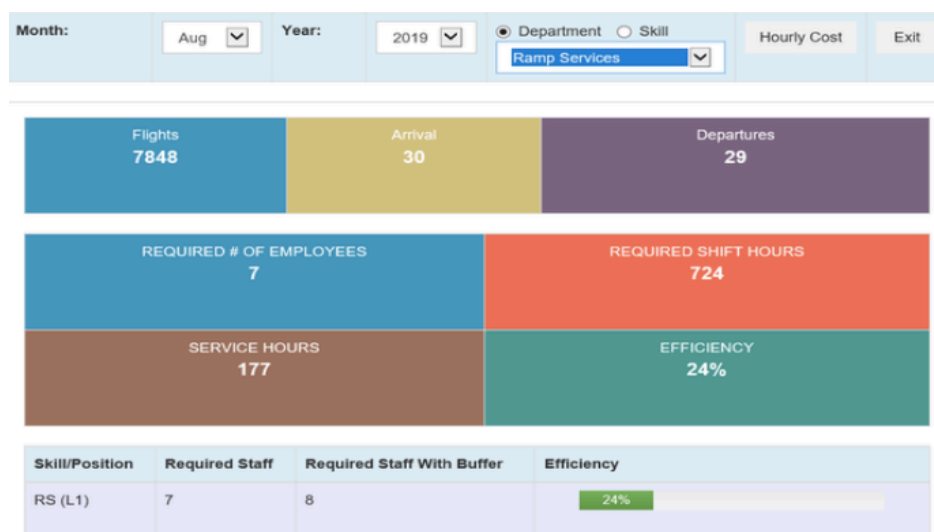

Figure 15. Simulation Module. (Rsmart and DXC/ Unpublished Tender Material)

3.4.8 Automatic Flight Data Monitoring

The system has the capability to integrate with the external system to fetch the real time flight performance data. This is a continous monitoring of the flight data to understand if there are any changes to the agreed precision time schedule. If there are any changes indetified by the system, the system will automatically alert the supervisor on the changes of flight and prompt for re-allocation of roster. (Rsmart and DXC/ Unpublished Tender Material)

3.5 Digital Twin

According to Kevin O'Sullivan digital twin is a virtual form of a physical asset, a similar use of the system can be seen in the fromula 1 teams, which they use it to analyze the car itself while its going around the circuit. (SITA)

This system also allows the formula one team to make changes in the car without touching the actual car itself, to determine the reaction of speed and fuel changes in the car. (SITA)

Airlines can use the Digital twin to get a simple source truth of the operations, identify deviations and its impact and execute corrective measure with defined benefits. (Rsmart and DXC/ Unpublished Tender Material)

What are the benefits of using digital twin is that, usually airport data is spread across in more advanced control headquarters. And due to this when all the data is collected and put on a one table independently it can cause disruptions and can be difficult to study the whole matter. (SITA/ Rsmart and DXC/ Unpublished Tender Material)

With the digital twin it collects the data of all the activities that are happening at the airport from arrivals/departures to passenger activity as well. Digital twin brings all the data together in one place instead of independently collecting the various datas. (SITA/ Rsmart and DXC/ Unpublished Tender Material)

Digital twin improves the decision making based on the previous operations, it can also play back an operation from the past step by step for an analyzed study. (SITA/ Rsmart and DXC/ Unpublished Tender Material)

Digital twin can also be loaded with the datas like weather information, flight information and other various operations that takes place at an airport, and we can successfully analyze and predict with the help of digital twin that what's gonna happen at the airport in future. (SITA/ Rsmart and DXC/ Unpublished Tender Material)

Figure 16. Digital Twin Module. (SITA)

4. Why Digitization is required in Aviation Cargo Sector

There is a huge demand for the digitalization in the air cargo industry as it still lacks behind in terms of technologically, whereas the commercial industry provides various digitized options for their customers or the market. For instance, the commercial industry provides their customers with digitized shopping experiences,

electronic tickets but in the case of air cargo sector their database still have to rely on the old-fashioned channels such as call centers for them to promote their rates. (Siapartners, 2018)

Air freight sector also lacks behind in the environmental steps that has been taken by every other sector as they still rely on the paper based documentation, for the shipment information's to be exchanged. (Siapartners, 2018)

Due to the Covid-19 situations the air cargo industry has been struggling to be more efficient and useful during these times. As due to the pandemic the demand for air cargo has been increased rapidly to support the transportation of medical supplies in high quantity worldwide. Air cargo industry has been losing out on a lot due to less manpower and high freight rates, for which software developers has come out with the best solutions for the industry. (Stattimes, 2020)

According to the Henk Mulder, head of digital cargo IATA complete digitalization of the workplace has been one of the most important factor for the air cargo industry to keep moving forward smoothly and efficiently. (Stattimes, 2020)

EPIC (enhanced partner identification and connectivity) a tool launched by the IATA to digitalize the connectivity procedures and standards, and to develop a dig-italized collaboration between the air cargo industry stakeholders such as airlines, ground handlers and the customers itself. (IATA, 2019)

Figure 17. Enhanced Partner Identification and Connectivity System. (IATA,2019)

Air Cargo industry also struggles with hassle of creating paper documentations, which is why the Kale Logistics came out with their new module to tackle this problem. They introduced "PING" which is a module specially designed for handling the freight documentations in a more efficient and cost-effective way. Letting the cargo companies to focus more on their operational activates. The PING is comprised of: (KaleLogistics)

- Document to EDI converter Service

- Trade Documentation Service

- Cargo Track and Trace Service

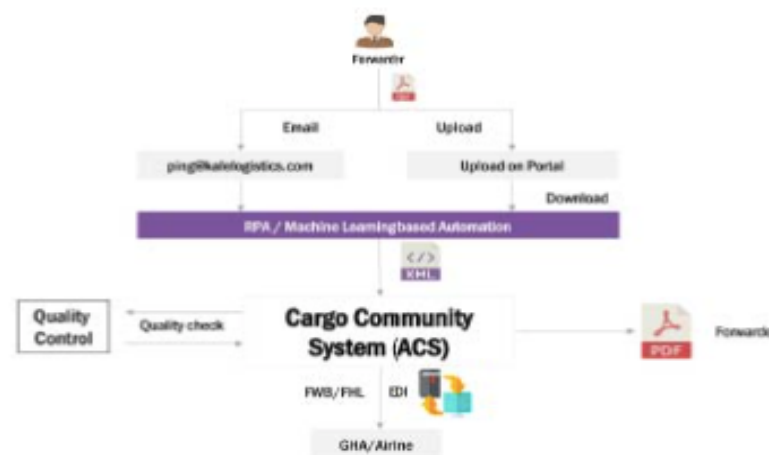- Rate Management Service

- Freight Audit Support

Figure 18. Kale Logistics "PING" (Stattimes,2020)

IATA shows the increase in implementing e-AWB with its new study in the below mentioned graph. According to the study done by IATA industry is saving up to 15-20% of administrative cost by the use of e-AWB. (TheLoadStar, 2020)

The main benefits of e-AWB is that it doesn't requires the need of paper AWB and also speed up the process of billing and in an efficient way. Reducing the cost and burden for the cargo industry businesses. (Globaletrade, 2018)
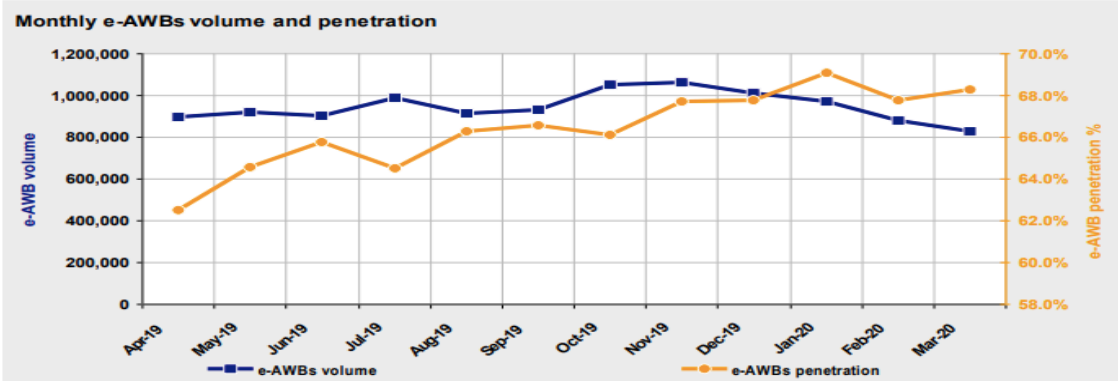
Figure 19. e-AWB growth stats by IATA (IATA/TheLoadStar, 2020)

5. Data Collection Method

The majority of primary data were collected during the author's internship in the Rsmart through product presentations, onsite demo's and aviation conferences of the product suite with number of prospects from around the world, giving a wider look on how these solutions can also effect culturally. As number of managers and employees joined these programs so the author was able to already collect sufficient data in a form of "question and answers" according to the prospects needs and what they expect from a product like this.

The company programmers also play big role in finding some of the data that the author was able to obtain.

For the interview purposes, the author was able to have an interview cum presentation personally and following virtually at conferences with some of the aviation professionals during the author's time in the company, to get their deeper view on the digitalization of the aviation operations.

5.1 Advantages of face-to-face data collection

Face to face data collection can be really beneficial for an accurate and efficient data collection procedure. You can maintain the focus, notice emotions and different behaviors according to the questions and get a more better experience of data collection procedure. (Snapsurveys)

5.2 Research Data creation

The creation of data was mainly done through sales presentations to our prospects, as during this process we are expected to get a full view of our client's operations and their needs, and what they are looking for from the various modules that we have. In this process, we are expected to get the full operational Information of a prospect like number of problems they are facing, number of employees, annual turnaround activity, existing solution (only if in use) and how our solutions can benefit the prospect company.

The process took place with various organizations within the aviation industry like ground handling companies, airports, airlines maintenance and catering company.

There were some pricing discussions as well but not in a detailed manner as it's a much more complex and sensitive topic, but a ball park idea was able to obtain during the collection phase.

The main responders for the data ranged from ramp agents to operation managers during the presentation phase of the collection and during the demo session there were much more variety of respondents including financial managers, project managers and station managers.

The timeline of this primary data collection done by the author ranges from July 2019 to February 2020. Companies like Tiger Aviation Egypt, Aviapartner Italy, Aviator Finland, Airpro Finland, AVJet Canada, Sodexo Finland and Blue Aviation Kuwait.

5.3 Interview Data collection

The interview was focused more on department professionals including the aviation consultants. The answers provided a very in-depth path for the digitization in the aviation industry.

The author had a good reach to collect data personally from various professionals including top level managements.

The author was also able to collect some data with the help of colleagues who were present on 21st Annual Ground Handling Conference which was held in Amsterdam on November. Tech professionals related to the designing and programming of these solutions were also interviewed to get their opinion on, how it has affected the industry, how beneficial it has been for the industry and how it's going to be in future.

The period of collecting interview data was as same as used for the above primary data. As the main reason for the interview was to get an in-depth information on the following advantages of the solution.

5.4 Validity and Reliability

For this thesis, the theoretical data was created with the assistance of several online resources, articles, unpublished company materials and tender files. The data is up-to-date and gives a deeper understanding of the topic, in the current world perspective prior to the Covid-19 pandemic. The company materials used were also updated resources, used for a tender process in 2019 with all the upgrades that has been done to the solution, which gives an accurate information and understanding of current stage of the solutions. The data without the sources were completely related to authors own points and knowledge. The remaining resources were also collected from reliable sources in the aviation industry like IATA, FTE, Aviation Business News, Times of India and Finavia.

The research data questions were also created strategically for professionals to know the aviation company's current situations and how these solutions can benefit them. For the tech professionals, the questions were more related to the solutions background and its outcome in the industry. As the data was collected in live carefully with transparent and industry related questions, which gave clear results and the author was able to analyze the respondents attitude and behavior towards following questions. Which according to the author, was clear and concise.

6. Research Results

The research results shown down below is not divided by country or a company or a person, it's a combined result. Countries or backgrounds are not specified until it gives a more value to the research. The results will be presented in a graph form, and there were around 20 respondents including employees, agents and managers that contributed their responses to this research. In this list of respondents everyone has more than 2 years of experience in the aviation field. It also need to be taken into consideration that all the responses collected were prior to the pandemic period. The questions were created strategically to know the companies exact needs, what kind of solution they prefer the most and what is the most critical area for the company to handle.
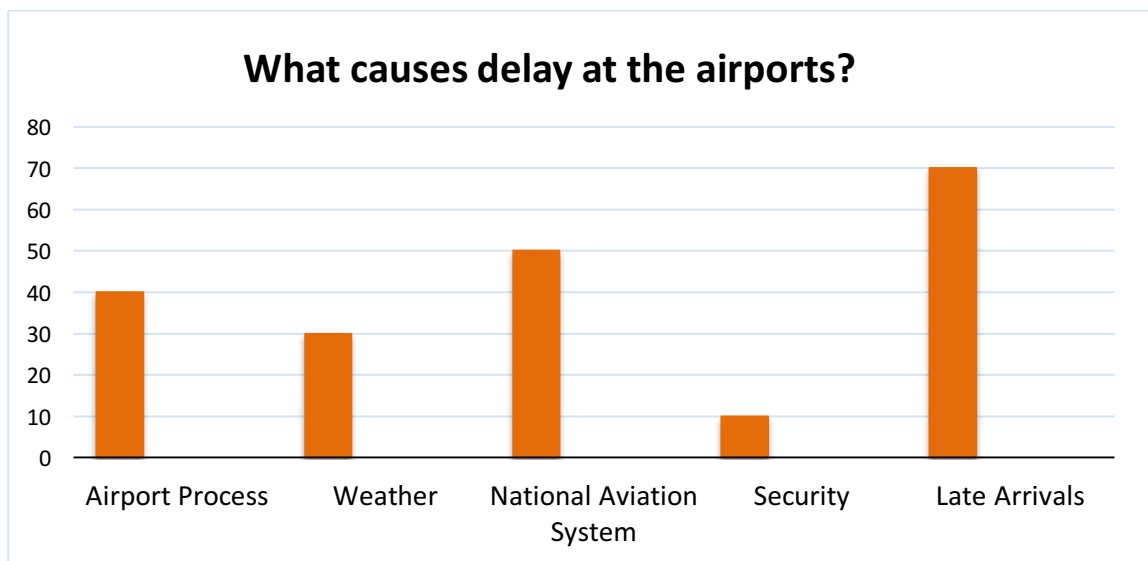
Graph 1. Results for causes of delay at the airport?

The question was sourced from Bureau of Transportation Statistics. The above data shows that one of the major reasons that causes airport delays are Late arrivals of the flight. The respondents also gave some reasons why this could happen which was as follows, late clearance from ATC and go around procedures due to bad weather. 5 respondents mentioned National Aviation system as one of the cause which can caused due to Airport construction and conditions, Bird strikes,
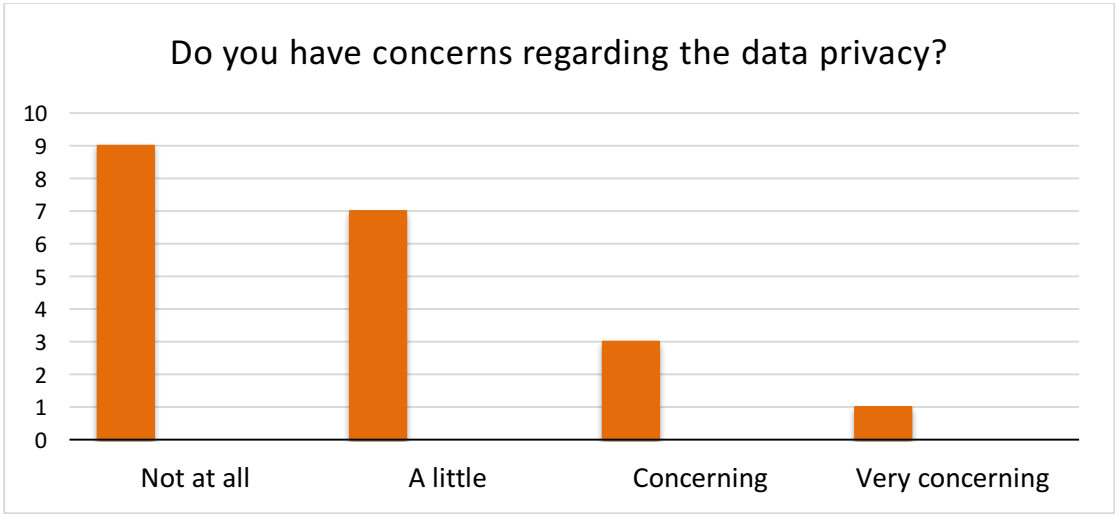
closed runways, FAA flow control program and volume delays. 3 respondents answered weather can be responsible due to snow which requires de-icing process, pre-planned cancellations due to weather and holding of the gate for en-route weather. These respondents were mainly from Finland and Canada as due to the weather in the country Finnish and Canadian aviation faces these problems. Airport process were also mentioned by 4 respondents as cause of delay due cabin servicing, baggage loading delay, aircraft cleaning, paperwork and gate congestion. Only 1 respondent mentioned security can be the cause of delay which includes defective screening equipment, re-boarding passengers due to the security threat and weapon confiscation. Some of these responses shows country based issues like in the case of weather conditions.

What are the most preferred module?
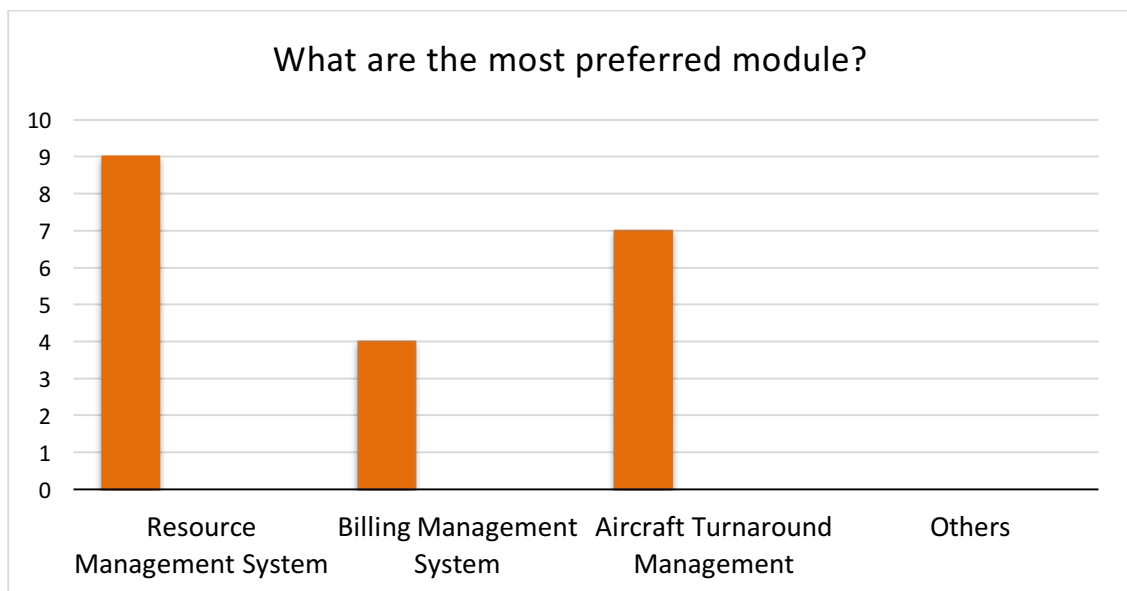
Graph 2. What are the most preferred module?

From the research, it was surprising to find out that the most preferred module was RMS than ATM. 9 out of 20 respondents chose RMS as the most important module because of large number of operations and size of employees. More number of employees in a company it gets harder to manage a huge workforce, and it can cause a big revenue leak. RMS was mostly chosen by the representatives of big companies with large operations. ATM was considered as the second most favored module chosen by 7 respondents to eliminate the delays caused at the airport. BMS was the least preferred as it only got 4 votes in this research, which was also amazing to conclude that it can eliminate most of the paper work procedures,

revenue leaks and can help the company's focus more on the environmental goals.

Do you have concerns regarding the data privacy?

Not at all	9
A little	7
Concerning	3
Very concerning	1

Graph 3. Do you have concerns regarding the data privacy?

During this question, most of the respondents were not willing to open up very much. But number of the respondents were not concerned at all about the data privacy issue, 9 of the respondents were satisfied with the company's security architecture. Some respondents raised up the question regarding the company's server location, privacy, access and less control over the way data will be stored. One of the respondent even raised up the question about if there's any political interference in the company's database, which was understandable due to the origin of the company.

Cloud based vs Hardware?

Cloud Based	20
Hardware	
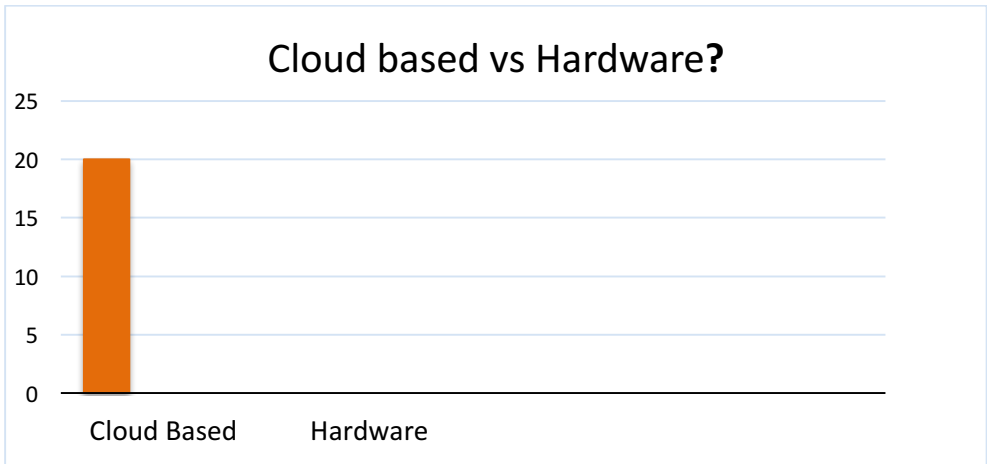
Graph 4. Cloud Based vs Hardware?

In the above graph 4 the situation of cloud based or hardware, all the respondents leaned towards the cloud based approach as its more efficient and cheap. They also mentioned few environmental benefits as well regarding the cloud based approach. Backing up of data is much easier, minimizing the data loss as compared to hardware, and it was the best option for the clients as the company were ready for a full on open collaboration. But the respondents did have some concerns in terms of sensitive data breach and accessibility of the data.

A secondary data has been mentioned below of a research done by Noel Radley, 2014 Showing how the on-premises hardware system demand has been falling since 2008. More and more companies even outside the aviation sector are opting for a cloud based computing. (SoftwareAdvice)
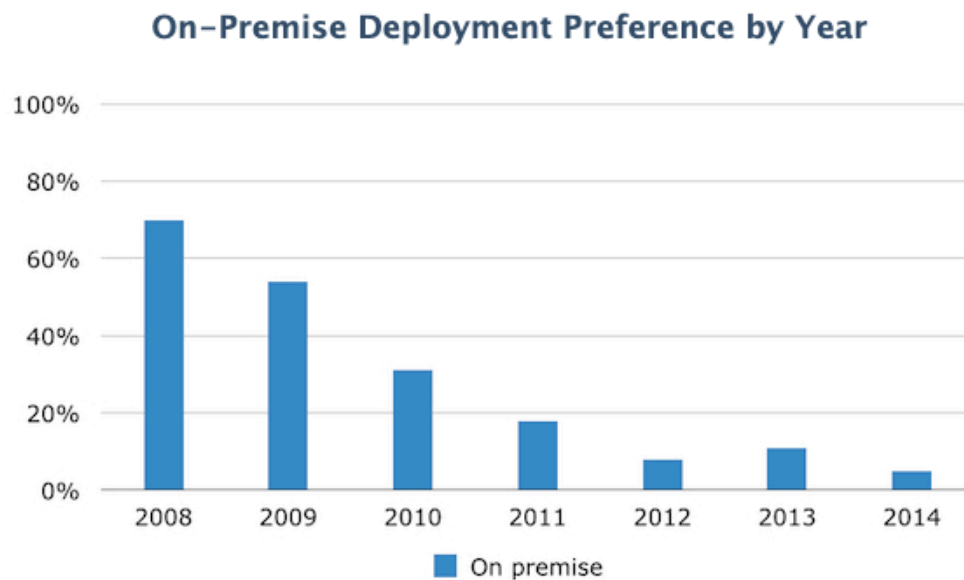

Figure 20. Hardware Preference by Year (SoftwareAdvice)

But still in this generation hardware is still considered a main role within the cloud computing. A large sum of money is invested into the hardware based solutions to back up the cloud computing problems that can't be solved just by the use of software. (SIliconAngle, 2019)

The cost of data recovery on a cloud based server can give a huge burden for the companies. (Sysgen)

Most Challenging areas to digitize?
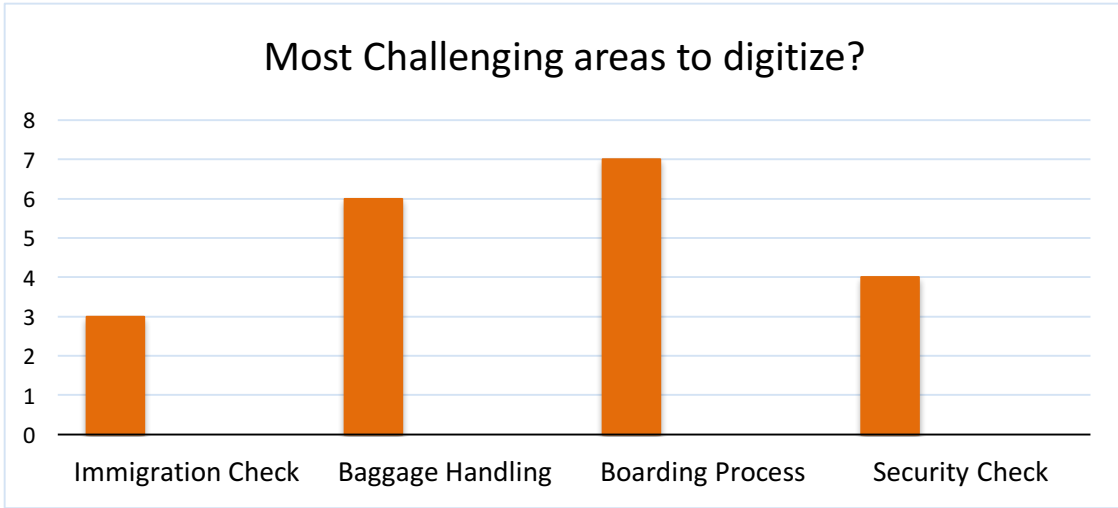
Graph 5. Most challenging areas to digitize?

The above research question, answers the technicality to digitize the different services within the airport. According to the respondents, the most challenging area to digitize would be the boarding procedure, 7 respondents were agreeing to this point. The second most challenging area would be the baggage handling process for which around 6 respondents voted. Following areas were the security check and the immigration processes. With 4 votes going towards the security check area and the least votes going for immigration area. It is understandable that why immigration check got the least votes because a simple implementation of a biometric passage gates can digitize this area. Which is considered less challenging than the other following areas to digitize. Digitizing these areas are really crucial for the aviation to improve the passenger experience.

Most used device by aviation employees worldwide.
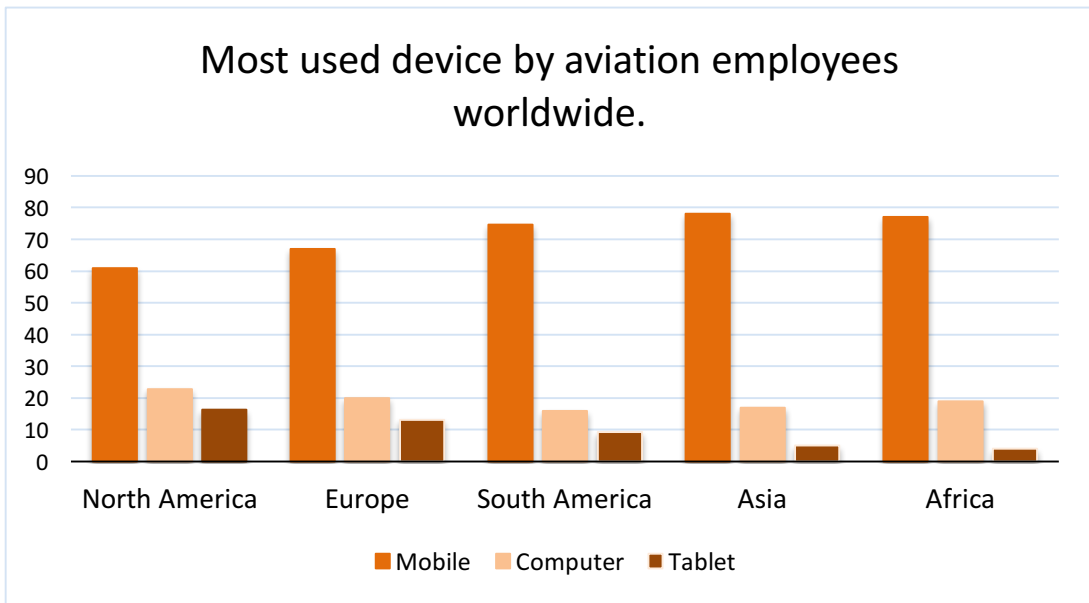
Graph 6. Most used device by aviation employees worldwide.

The above data was retrieved from the respondents as well as the Rsmart database "on what devices the company solutions are mostly used"? As it's clear that the employees use mobile as their main device to operate these solutions. Especially in Africa and Asia which are two of the biggest emerging aviation markets, the use of mobile over any other devices are preferred more. More than 70% of workforce operate through mobile devices. This research also present that the companies providing these solutions to the airports should keep their system more mobile friendly and compatible.
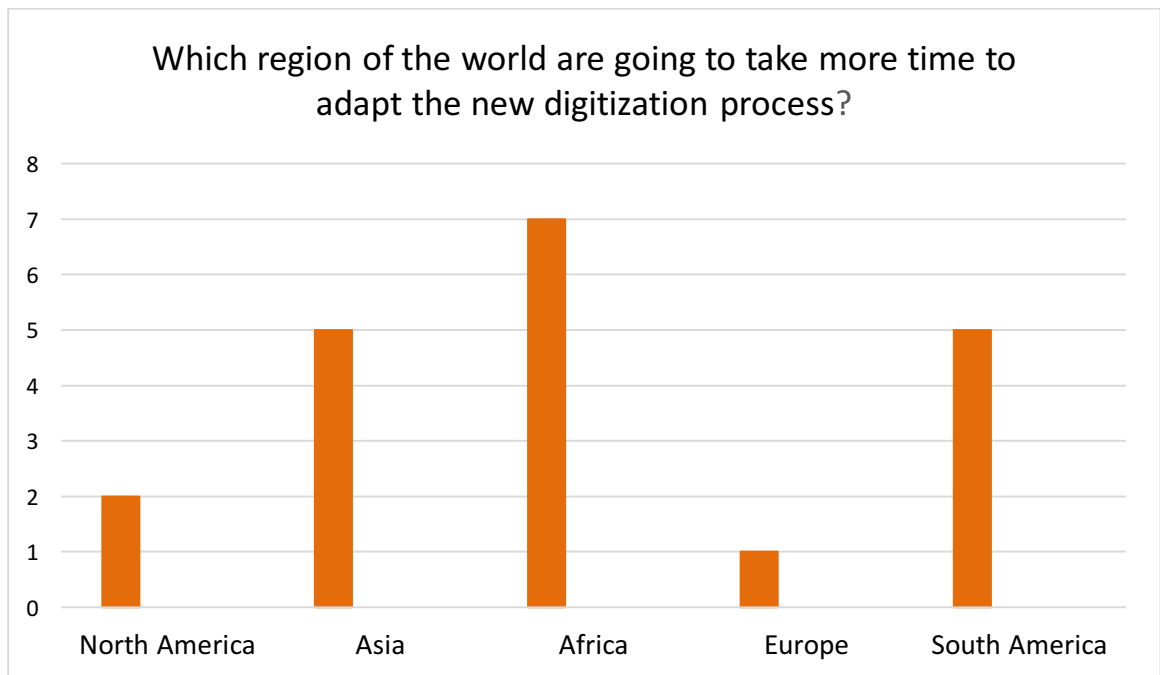
Graph 7. Which region of the world are going to take more time to adapt the new digitization process?

As from the above results we can understand that according to the respondents Africa will take the most time to adapt followed by Asia and South America. This is believed due to the different cultural believes, method of working style and time to adapt the new technological changes. Tiger Aviation from Egypt, the manager mentioned that the younger workforce was ready to learn and adapt to the new digitalized solutions whereas, the older group of workforce were not comfortable to change as they wanted it to stay as same as it was before. This lead to canceling the implementation of the solutions by Tiger Aviation.

6.1 Summary of data collected

From the above research data, we can visualize some of the major problems that the aviation industry is going through. There are also many concerns regarding the solutions, which the companies providing these particular solutions need to take into action and make themselves more reliable for their clients. There were also some data regarding the gender and age of aviation employees, according to the data more than 80% of employees working in the ground handling or as an airport staff is considered to be from male category and the majority age group is from 22-40 years old. The data also shows how the younger workforce is keener towards the digitization than that off the older workforce, and when these aviation companies prefer resource management as the most important part of digitization within their employees this clashes with company goals and employee's satisfaction. Taking this in mind, the main goal for the companies facing these issues would be to bring everyone on the same page. Every respondent agrees with the cloud technology, but the technology has its own downside which the respondents mentioned. The solutions providers are looking into these issues, on how they can improve the existing system, this will be discussed more in the interview research data phase.

6.2 Research data from the aviation professionals

The session begins with a short background introduction of interviewee, including the qualifications and the experience in the aviation field.

The most important part for the respondent was, why the aviation industry is rapidly moving towards the digitization. According to the respondent, the aviation industry is expected to double and over crowd the airports in next coming 10 years. Every sector within the aviation industry is a part of digitalization race, including airlines, ground handlers and rest of the sectors. Every company wants to improve their operations and want to be ready to accept the changing expectations and better customer experience.

Few benefits that the digitalization can bring according to the respondent was that it can make the operations efficient and effective, less human errors resulting in no more delays and less revenue leak, better management of the operations, minimal fuel costs and better flight planning and many more benefits. These can improve both the passengers and customers experience within the aviation industry.

When it comes to environmental goals, aviation industry is doing their best to go green in the most effective way.

Digitalization can also help achieve the environmental goals according to the respondents. Digitization will make the paperless e-documentation successful, pilots will be able to check, complete and upload the necessary documents with the use of just one single device that will be present on the flight itself and will be connected to the gate. Minimizing the workforce, workload and paper documentation processes. Fuel consumption will be improved as well with the help of digitized solutions by keeping the track of fuel consumption levels.

The whole industry can work under one roof of system by bringing in the pilots, gate staff, ramp agents and ground staff together. This can be done to give everyone a same view of the flight with a real-time information updates, making the operation more efficient. If an employee is missing/absent, the system can produce an alert which will send another employee to fill up the space.

Operations will be more automated and will take less human effort to plan such extremely complex processes.

When it comes to the pricing point, most of the respondents were not ready or was comfortable to spend a huge expense. Rsmart was aware of these situations so they introduced a subscription based cost structure, which is basically the amount of your operation is, that would be the amount payable. For example, one turnaround equals to one euro model was introduced by Rsmart. This was a really good option for the aviation companies and they were comfortable with this pricing range.

Aviator and Airpro respondents from the Helsinki Airport answered that they handle around 3000-4000 turnarounds monthly, which would be 3-4 thousand euros of monthly expense from their behalf on making their operations digitized. As digitization is considered necessary for them as they are two of the biggest ground handling companies in Finland.

Aviator respondent also mentioned about their current system that they are using for their operations, which is a solution from Damarel. They were not quite satisfied by the system itself and its complexity.

According to the respondents, bringing digitization can be really expensive and many companies are not ready or comfortable to invest that much amount. Aviation companies has to spend millions on operating costs alone, which leaves these companies with less margin for the profit.

The conferences are a really important part for the aviation companies as they get to market and display their products or services to various different companies within the aviation world. They also get to present their product in front of potential group on the main stage, and according to the respondent more than 60% of their clients were acquired from such conferences due to being an B2B industry.

6.3 Research data from the tech professionals

According to the respondents, the main upgrade they would want to make is bringing in the IOT feature into the system. Which has been pretty challenging for the

team, they are looking forward to automating the system completely in the coming future without needing any human interaction.

According to the respondent, robots and other Artificial intelligence at the airport are going to specifically improve the passenger experience specifically but for the ground handlers and airports, their main goals are how to achieve the maximum operation efficiency with less operational cost.

Also trying to make the auto allocation procedures more accurate and reliable. They are also looking into integrating the system with the CCTV's. Which was a requirement by the Oman ground handling company in their tender.

Due to the concerns brought up by the clients of data breach and loss, the respondent also mentioned about upgrading the security architecture and taking the full advantage of the Amazon AWS.

When it comes to aviation 4.0, the respondents have a really positive view. They believe that stepping up the passenger experience has been the target for every companies within the aviation sector, and that is what exactly they work towards as well to step up the customer expectations and secure the air travel by making the operations efficient and reliable.

One of the respondent, who was the project leader and also is the lead engineer during many implementations of the system in the airport mentioned that many employees can find it hard to operate these systems. It is a complex procedure for some part of the workforce who doesn't have an IT background. That is why the tech team have been trying to make the system look more attractive and appealing using different bright colors within the dashboards and various tabs for the certain workforce.

Being able to customize the system according to the company/country laws and regulations gives the Rsmart system a hand over other solutions that are in the same market right now. The system is fully customizable from the view point as well as restriction wise. The system can be restricted for the employees, which will only show them specific tabs that they are supposed to view, whereas managers can get a full access.

It has been really productive for companies using the solution. As their servers are growing day by day because of the full capacity usage by their clients. And they have been getting really positive feedbacks regarding the system and its capabilities.

7. Conclusion

As per the research of this topic, it is easy to conclude that there is a huge demand for these systems and solutions. As aviation industry is growing day by day, new airports are being built, number of aircrafts are increasing both domestically as well as internationally and due to which the operations are getting more complex to keep up with. Companies are trying to adopt these solutions to make their operations more automated and efficient to save a huge operational cost, minimize the human errors and delays caused by such actions.

The main objective of this thesis was to conduct a research and analyze about these solutions and how they can improve the efficiency of industry and solve the difficulties that they face during operations. This research has also pointed out few cultural difficulties in some parts of the world that might cause a disruption for moving towards digitization.

Cloud technology has been the most preferred tech around the industry even after having big complications within it.

Privacy of data was also a main concern, that was pointed out during the research. The solution providing companies need to take this into account and become more reliable among the industry to tackle this issue, by adopting the best security architecture.

During the research, aviation professionals gave an insight on why the aviation industry is rapidly moving towards digitization, how these solutions can be beneficial, the environmental goals that the companies can achieve using these systems and how the whole aviation industry can come and work together under one ecosystem with the help of these solutions.

The pricing was also mentioned during this research. Which is a subscription based pricing model introduced by Rsmart, where the aviation companies don't have to spend millions of dollars. They pay according to the size and level of their operations, which the industry seemed to be satisfied with.

Tech professionals also provided more beneficial data into this research. Where they talked about how they are trying to upgrade the current system, how the current clients are reacting to their system and all the customizable attributes of the solution that they are providing to make it easier for the users to interact and operate.

The research method used for this thesis was a slight different approach, through live data collection from aviation employees, managers, professionals, consultants and the tech team during the authors internship in Rsmart.

The research for this thesis was done prior to the Covid-19, after the pandemic the industry has been came to a halt and the operations has been decreased drastically.

7.1 Future Research

For the future research relating to the same topic, a furthermore exploration can be done, on how the demand for these solutions has been changed and how the solutions providers are coping with this due to the Covid-19 situation. Also getting public opinion or adding passenger experience data might be considered an advantage, to get a more in-depth view on how these solutions are changing the travel experience as well, furthermore what can be done to make the passengers experience better. This research can also be done targeting solutions that are used specifically to improve passenger travel experience, reaching higher air travel audience and conducting a survey, also it can be a focused research on a single country's aviation industry.

7.2 Learning Outcome

During executing this thesis, I was able to reflect my knowledge and experience gained from working in the aviation industry. As I was passionate about working in the aviation, from the beginning itself I wanted to do my research related to the aviation topic as well. So, I decided to go with this case, which I had knowledge and experience off. Professionally I was able to develop and expand a lot of skills

during this research like project management, critical thinking, communication, interpersonal and time management. I am also thankful and grateful to Rsmart and my supervisor for assisting me during this thesis and research phase. I was also lucky enough to meet number of professionals during my internship and to showcase their thoughts in this research. Not only that I was able to develop professional skills but I was also able to get a deeper understanding of the industry itself.

I am pretty satisfied with the results that I was able to produce, but I wish I could generate more research data from the professionals on this topic of digitization especially from the Asian and African continents as to see how well they are adapting to the digitization culturally.

Personally, I have never done a thesis before, and going through this process was really knowledgeable and beneficial to develop my research skills. In the end, I was able to gain several skills which could help me in my future endeavors.

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9. Appendices

9.1   Data Result Part One

Q1. How many years of experience do you have in the aviation industry?

| Number of Years in experience	Percentage	Responses Total Respondents = 20
0-1 Years	0%	0
More than 2 Years	35%	7
More than 5 Years	55%	11
10 or More Years	10%	2

Table.2 Number of years in experience

Q2. Number of turnarounds annually in the respondent's respective airports?

Number of Turnarounds annually in the respondent's airports?	Percentage	Responses Total Respondents = 20
Less than 50,000	45%	0
50,000 – 100,000	25%	5
100,000 – 200,000	60%	12
More than 200,000	15%	3

Table.3 Number of turnarounds annually.

Q2. What causes delays at the airport?
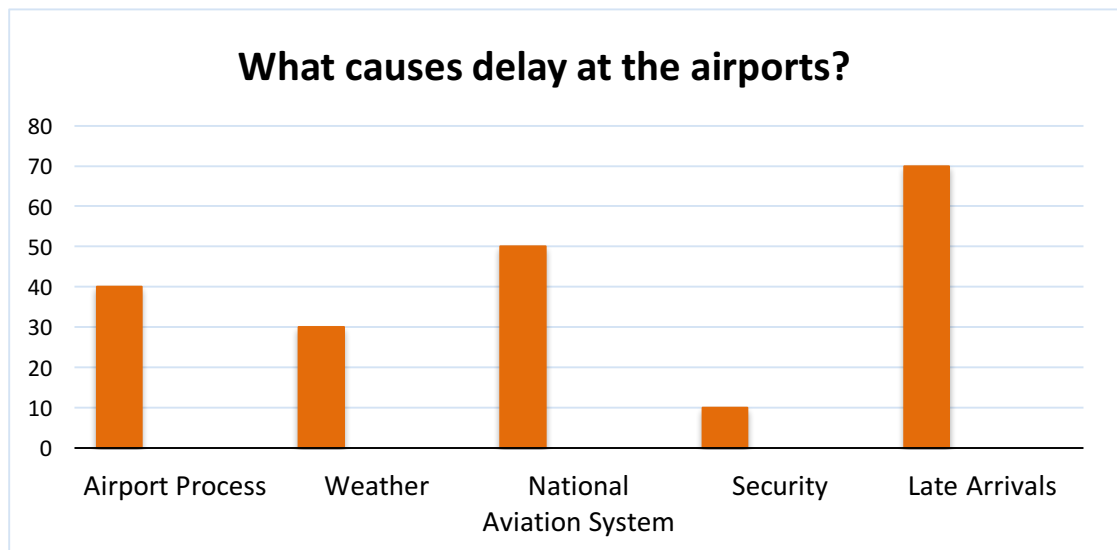
What causes delays at the airport?	Percentage	Responses Total Respondents = 20
Airport Process	20%	4
Weather	15%	3
National Aviation System	25%	5
Security	5%	1
Late Arrivals	35%	7

Table.4 What causes delays at the airport.

Q3. What are the most preferred module?
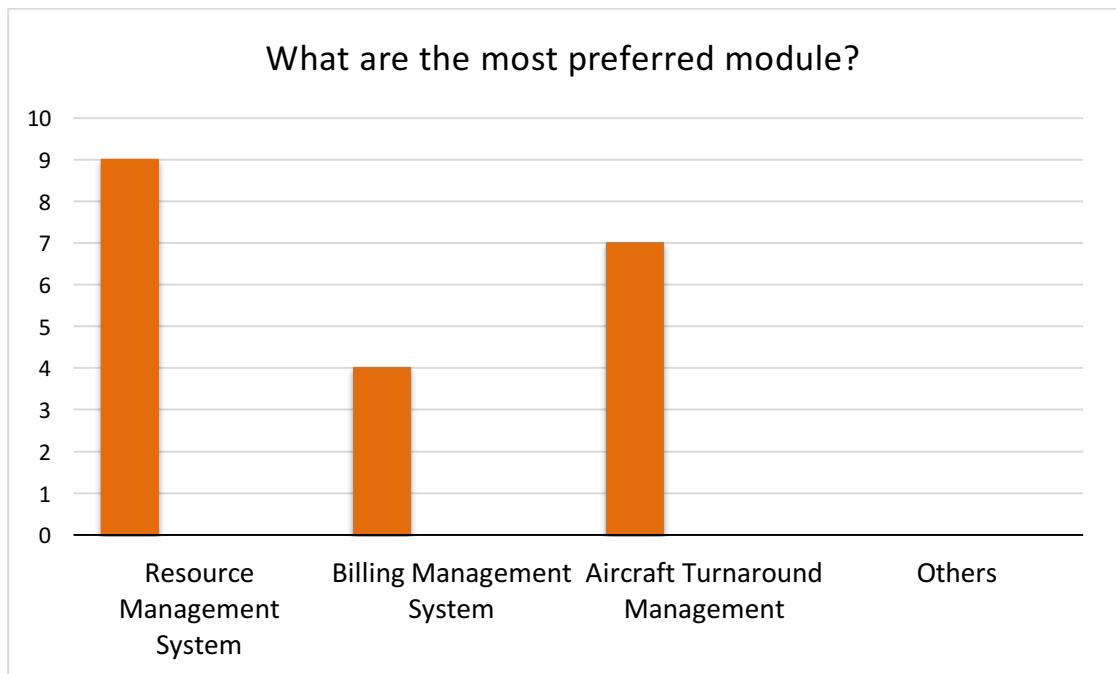
What are the most preferred module?	Percentage	Responses Total Respondents = 20
Resource Management System	45%	9
Billing Management System	20%	4
Aircraft Turnaround Management	35%	7
Others	0%	0

Table.5 What are the most preferred module?

Q4. Do you have concerns regarding the data privacy?
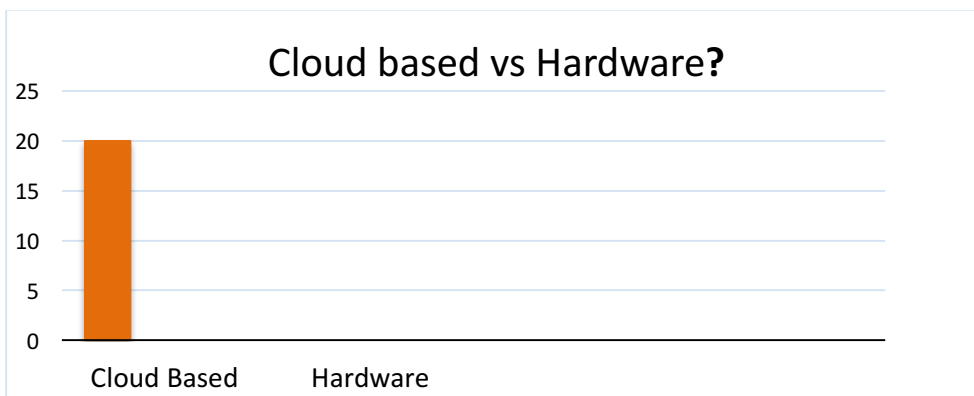
Do you have concerns regarding the data privacy?
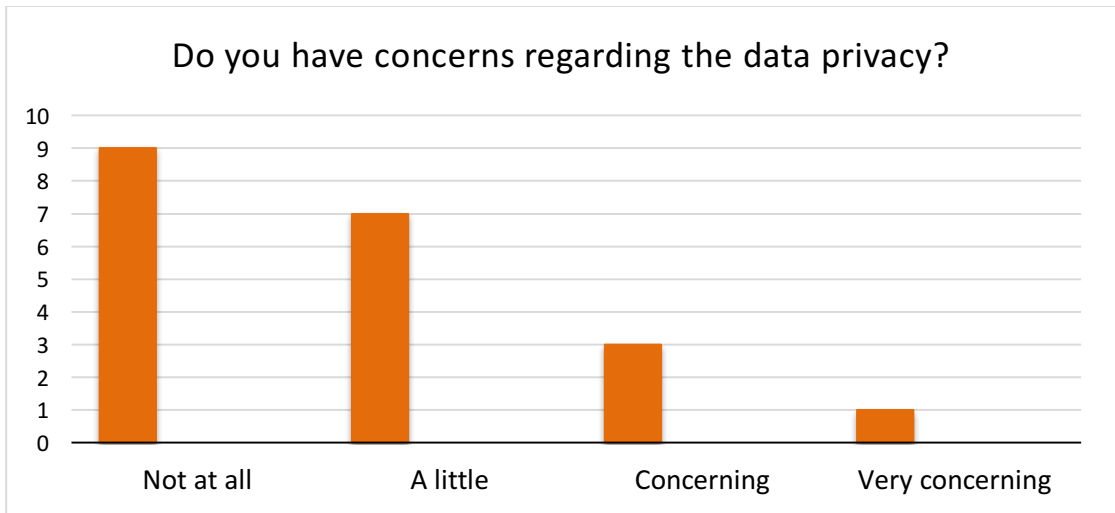
Do you have concerns regarding the data privacy?	Percentage	Responses Total Respondents = 20
Not at all	45%	9
A little	35%	7
Concerning	15%	3
Very concerning	5%	1

Table.6 Do you have concerns regarding the data privacy?

Q5. Cloud based vs Hardware?

Cloud based vs Hardware?

| Cloud based vs Hardware?	Percentage	Responses Total Respondents = 20
Cloud Based	100%	20
Hardware	0%	0

Table.7 Cloud based vs Hardware.

Q6. Most Challenging areas to digitize?

Most Challenging areas to digitize?
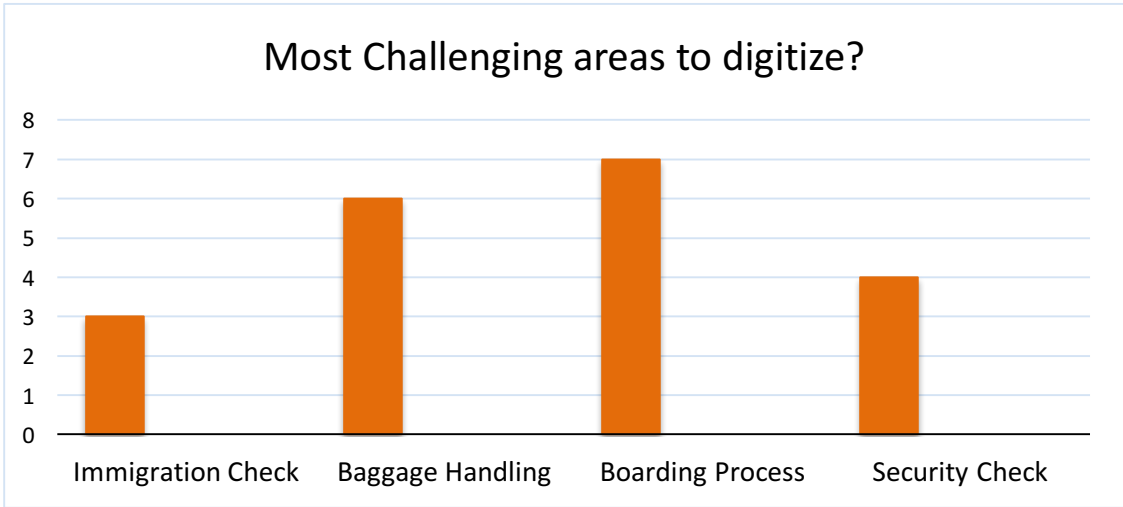
Most challenging areas to digitize?	Percentage	Responses Total Respondents = 20
Immigration Check	15%	3
Baggage Handling	30%	6
Boarding Process	35%	7
Security Check	20%	4

Table.8 Most challenging areas to digitize?

Q7. Most used device by aviation employees worldwide.

Most used device by aviation employees worldwide.

■ Mobile ■ Computer ■ Tablet
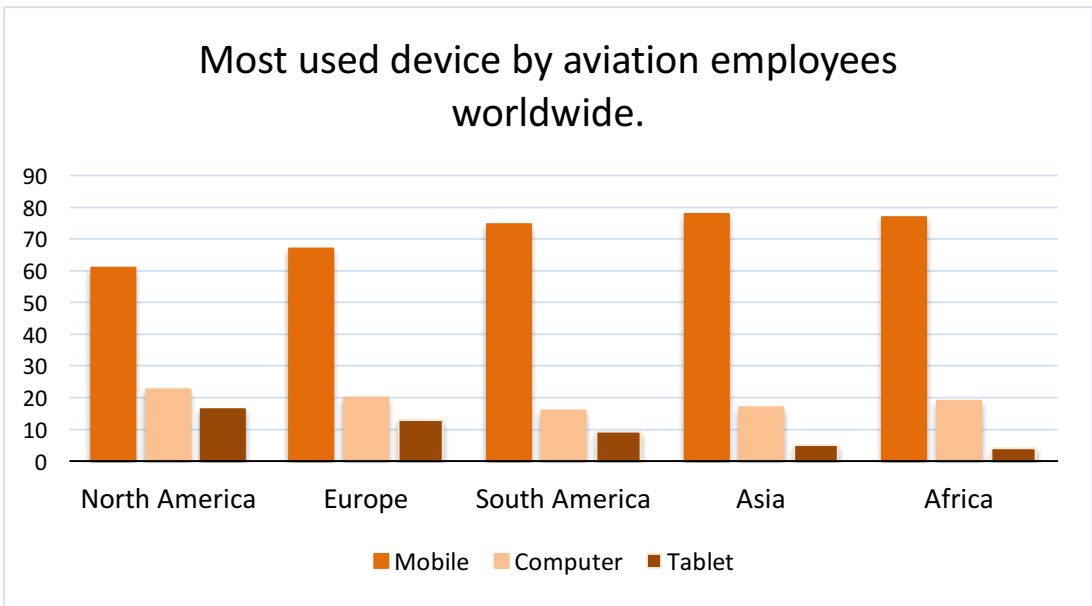
Most used device by aviation employees.	Mobile	Computer	Tablet
North America	60.89	22.73	16.38
Europe	67	20	13
South America	74.72	16	9.28
Asia	78	17	5
Africa	77	19	4

Table.9 Most used device by aviation employees.

Q8. Which region of the world are going to take more time to adapt the new digitization process?
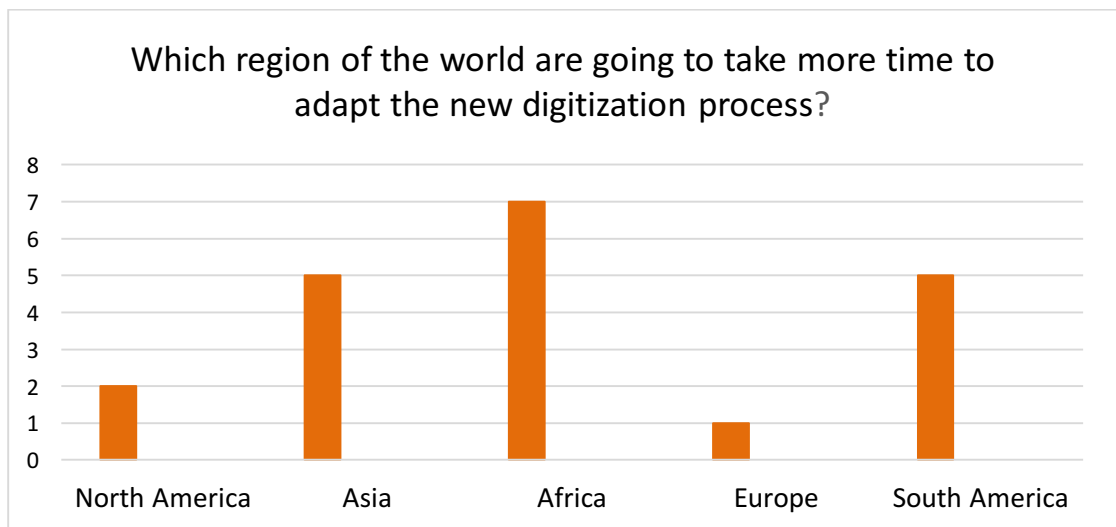
Which regions of the world would take more time to adapt to the new digitization?	Percentage	Responses Total Respondents = 20
North America	10%	2
Asia	25%	5
Africa	35%	7
Europe	5%	1
South America	25%	5

Table.10 Which regions would take time to adapt the new digitization.

9.2 Data Result Part Two

9.2.1 Questions for professionals

Q1. Could you please describe your background and experience within the aviation industry?

Q2. For how long have been working in the present company?

Q3. Why the aviation industry is moving towards digitization?

Q4. What are the benefits, that the aviation going to have from this digitization?

Q5. How digitization can improve environmental benefits and the goals of a company?

Q6. How can aviation improve their ecosystem through digitization?

Q7. What is the price point that you are expected to spend with these solutions?

Q8. Would you be comfortable paying monthly subscription based cost for these solutions or you prefer a one-time big payment?

Q9. Do the employees of this company use any solutions presently?

Q10. Why conferences are so important for the aviation companies?

Q11. What is the main strategy behind these conferences?

Q12. Is it worth it for a small sized company to invest in conferences, especially an aviation based company?

9.2.2 Questions for tech professionals

Q1. What is the future of these solutions and what is being upgraded currently?

Q2. Why these solutions are important for the aviation?

Q3. Why companies are concerned about data breach and what is being done to improve and make it more reliable?

Q4. What are your views on airport 4.0?

Q5. Is it easy for the employees to operate these solutions?

Q6. What makes Rsmart different from other solutions?