Universitat Autònoma de Barcelona

escola d'enginyeria

THE MEDICALIZED AVIATION AND ITS OPERATIONS: ROYAL FLYING DOCTOR SERVICE OF AUSTRALIA, IMPLEMENTATION MODEL

Memòria del Treball de Fi de Grau

en

Gestió Aeronàutica

realitzat per

Irene Cabanes Batallé

i dirigit per

José Manuel Pérez de la Cruz

Escola d'Enginyeria

Sabadell, *Juliol* de *2015*

Universitat Autònoma de Barcelona

escola d'enginyeria

El sotasignat, ***José Manuel Pérez de la Cruz*** ,

professor de l'Escola d'Enginyeria de la UAB,

CERTIFICA:

Que el treball al que correspon la present memòria

ha estat realitzat sota la seva direcció per

Irene Cabanes Batallé .

I per a que consti firma la present.

Sabadell, *Juliol* de *2015*

Signat: ***José Manuel Pérez de la Cruz***

FULL DE RESUM – TREBALL FI DE GRAU DE L'ESCOLA D'ENGINEYRIA

Títol del Projecte: THE MEDICALIZED AVIATION AND ITS OPERATIONS: *ROYAL FLYING DOCTOR SERVICE*, IMPLEMENTATION MODEL	
Autor[a]: IRENE CABANES BATALLÉ	**Data:** *Juliol 2015*
Tutor: José Manuel Pérez de la Cruz	
Titulació: Grau en Gestió Aeronàutica	

Paraules clau

- CATALÀ: Aeronàutica, Royal Flying Doctor Service (RFDS), organització sense ànim de lucre, zones remotes sense serveis mèdics, trasllats a hospitals, rescats mèdics d'emergència, Austràlia, implementació, model RFDS, Espanya, trasllat d'òrgans, transplants, ONT.
- CASTELLÀ: Aeronáutica, Royal Flying Doctor Service (RFDS), organización sin ánimo de lucro, zonas remotas sin servicios médicos, traslados a hospitales, rescates médicos de emergencia, Australia, implementación, modelo RFDS, España, traslado de órganos, transplantes, ONT.
- ANGLÈS: Aeronautics, Royal Flying Doctor Service (RFDS), not-for-profit organization, remote areas without medical services, hospital transfers, medical emergency rescue, Australia, implementation, RFDS model, Spain, organ transfer, transplants, ONT.

Resum del projecte (extensió màxima 100 paraules)

- CATALÀ: En aquest projecte s'investiga a través de treball de camp el model operacional de *Royal Flying Doctor Service* (RFDS), una organització sense ànim de lucre que actua per traslladar pacients de regions sense serveis mèdics a hospitals en cas de necessitat. A través de la informació recaptada s'intentarà aplicar el model a Espanya, per facilitar el trasllat urgent d'òrgans entre regions espanyoles.
- CASTELLÀ: En este proyecto se investiga a través de trabajo de campo el modelo operacional de RFDS, una organización sin ánimo de lucro que actúa para trasladar pacientes de regions sin servicios médicos a hospitales en caso de necesidad. A través de la información recaptada se intentará aplicar el modelo en Espanya, para facilitar el traslado urgente de órganos entre regions españolas.
- ANGLÈS: This project investigates through fieldwork the operational model of RFDS, a not-for-profit organization used for the hospital patient transfer in areas with no medical services in case of an emergency. Through the information collected, it is intended to apply the model in Spain, to facilitate the urgent organ transfer within different Spanish regions.

Dedicated to my parents and to Mark Prior and Jenna Brown from RFDS,

I couldn't have done this project without their support,

Thank you!

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CHAPTER I - Introduction

1.1 Background

The *Royal Flying Doctor Service of Australia* organization has set an example to the world about how a not-for-profit should be run and be successful. Thanks to the consumer-oriented value proposition that they set in the beginning, which is offering health services to people in remote areas through air resources, now the RFDS has gained recognition and support of the whole Australian society. Most of the people living in Australia have their homes in heavily populated coastal regions, with access to first class medical help only minutes away. But in this country, there is far more than just cluttered safe suburbs, the inland is a large region where hundreds of thousands of people live but mostly travel. All these people get sick and have accidents too, and they are far away from the sophisticate health services, which most of the people who live in the coastal areas take for granted. Here is where *Royal Flying Doctor Service* comes to play its part; to meet these health needs, Australia has this unique organization.

Although the Spanish country doesn't need that specific service as all the areas are covered by good roads and have clinics and hospitals everywhere, it is worth studying the operational model of RFDS and see if, for the transplant operations that Spain is so famous for, its model could help to optimize the transport of organs.

1.2 Objectives

This project will focus on studying the operational procedures of the not-for-profit organization *Royal Flying Doctor Service of Australia* (RFDS) and try to apply them in some Spanish regions, to see if their model could fit in Spain.

Therefore, the following objectives are set:

GOAL 1: Familiarize with the Australian Aviation industry.

In order to be conduct the implementation successfully, a first contact with the environment where the *Royal Flying Doctor Service* operates is crucial. Consequently, it is important to be informed of the regulatory authorities they are controlled for.

GOAL 1.1: Become aware of the medical aviation statuses within the Australian regulation.

GOAL 1.2: Become aware of the airstrip requirements within the Australian regulation.

GOAL 2: Deepen the knowledge of the organization *Royal Flying Doctor Service of Australia* in order to form a clear idea of their operational model.

The key part for the success of this project is having direct access to information about the institution, not just obtaining data through the Internet. For this reason, a fieldwork seems to be an option that could fulfil the objective better.

GOAL 2.1: Establish contact with professionals working in RFDS.

GOAL 2.2: Have access to primary sources of information of the organization, such as diaries, interviews and observations.

GOAL 2.3: Have access to secondary sources of information of the organization, such as operational manuals, newsletters and history textbooks.

GOAL 2.4: Visit the ground facilities of RFDS.

GOAL 3: Study the compatibility of the current Spanish Aviation System with the RFDS operational model.

The second part of the project has as a main objective figuring out where RFDS operational pattern could be more needed and effective within Spain and see if a possible implementation could be done. For this reason, a deep analysis of the different regions of Spain will be required to do.

1.3 Motivation

The main motivation for doing this project is taking advantage of the ability to work within the Australian Aeronautic Industry in consequence of coursing the last year of the degree in Sydney. As I am not in my home country, I think that doing a project that contributed to the

Aeronautic Industry in Spain from an alternative and external angle can be an opportunity to learn within this topic from a different culture's perspective.

Moreover, the RFDS is a very relevant organization within the Australian society, almost everyone in that country knows the important work they do. For this reason, studying it from the inside I believe it is a way of integrating myself into the society I am living with right now.

I think that as a consequence of this project I will be able to connect with the Australian Aeronautic Industry but also, with the exploration of the possibility of implementing its model in Spain, I will help me gain more knowledge of the Aeronautic Spanish System in a practical way. In conclusion, I think I will learn new vocabulary, skills and capabilities that I hope will be able to apply in my future career.

1.4 State of the art

Although the aviation is an extended service all over the world, the medicalized aviation is not as a frequent practice. The characteristics of it makes that service a great transport: quick in time; opportune at the right time and place; appropriate by its quality; effective for its results; efficient in terms of cost-benefit, and secure because of the conditions.

First of all, its history could be defined as a mix of enthusiasm, scepticism, conservatism and audacity. In 1784 there was the "Brothers Montgolfier Air Balloon" episode, which consisted in recommending to patients pure air, as Doctor Jean Francois Picot suggested to his. Also, in 1909, the first airplane ambulance was used by army medical officers, Capt. George H. R. Gosman and Lt. A. L. Rhodeswas, when they used their own funds to build a plane to transport patients from the battlefield to medical care. Some years later, in 1917, a fixed wing aircraft was first officially used as an air ambulance in Turkey. From there, all the sanitary development has gone hand in hand with the military development, implemented in the post WWI-era, when in 1936 the first organized governmental air ambulance service was used during the Spanish Civil War. US dedicated use of helicopters in 1950 during the Korean War.

As mentioned in the paragraph above, though through the years the medicalized aviation has also evolved till arrive to the levels it is now, it has mostly been retained basically as a practice within the defence forces. The civilian use of air ambulances grew especially in North America, where there are several FAA-certified air ambulance services since 1946, and in Australia,

where Royal Flying Doctor Service or Little Wings organizations work; and they are all very advanced and are practical and effective for their patients.

But the state of the art of European and in particular the Spanish public civilian medicalized aviation is not developed much. Most of the public services are for rescuing people from mountains, or if there are frequent patient transported by air is usually through a private company, for example the Avijesa Flight Service company.

1.5 The memory organization

Following the guidelines of the coordination of the "Treball de Fi de Grau", this project is structured into different chapters depending on the topic treated. This configuration of the assignment is clear and easy to follow, as it is designed to gradually build knowledge of the area until the reader is prepared to fully understand the new proposal addressed.

After this first introductory chapter, the following one will focus on understanding the not-for-profit organization that works throughout Australia and helps the population that can't receive proper health services due to their isolated location. Its infrastructure, the type of professionals they employ, its emergency procedures among other subjects treated in this section, will help the reader understand why it is such a unique institution and how they work.

Basically, all the information will be documented after a long fieldwork and will be used as a base to implement their operational model in some specific Spanish regions, which will be found in the third chapter.

Finalized this section, a conclusion chapter will sum up the relevant focus points that have been treated in the project as well as a summary of the achieved and non-achieved objectives, and personal opinions about the outcome reached after the finalisation of it.

To make the reading more interesting and easy to follow, some pictures, maps and other figures can be found throughout the chapters.

CHAPTER II – *Royal Flying Doctor Service* aeronautics model

2.1 The *Royal Flying Doctor Service* organization

The *Royal Flying Doctor Service* (RFDS), also informally known as *The Flying Doctor*, is a not-for-profit organization that offers primary health care and 24 hour emergency services to Australia's furthest regions.

As stated in a RFDS video (RFDS National DVD/Video 2006),

> "the RFDS touches the lives of hundreds of thousands of Australians each year: to the people in less populated areas, the service means survival; and for isolated communities, it means the health services that people in cities have come to expect as a right".

For this reason, their mission is to provide excellence in aero-medical and everyday essential health care across Australia, guide by three values: dedication, vitality, and "for Australia".

RFDS has been running for over 85 years, which means it's the world's oldest and biggest aero-medical organization worldwide. It provides its services free of charge, meaning that every year it must find hundreds of millions to cover operational costs. About 75 per cent of this figure is met by the support of the Commonwealth, State and Territory government, but the RFDS also needs to raise several millions a year through donations from corporations and the community.

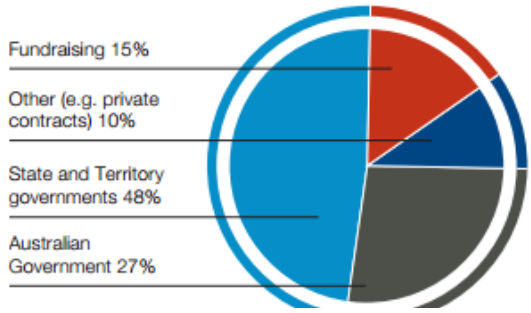

FIGURE 1: ORGANIZATIONS FROM WHICH *ROYAL FLYING DOCTOR SERVICE* RECEIVES MONEY

2.2 Professionals that work for RFDS

The not-for-profit organization employs health, aviation, marketing, communications, administration and HR professionals.

Although the corporate job positions might have the same recruitment process stages as a normal employment position in a random company would have, the health work positions in this organization especially have singular interviews and tests. Moreover, the applicant has to

demonstrate if he/she is capable of overcoming possible stress and pressure when they are transporting any serious injured patient while flying (which involves noise, pressure effects, vibrations, among others), as all those are necessarily to be taken into account.

After the selection process is finished, all the professionals have an extensive induction towards the organization as well as the RFDS they will be specifically working for. This course consist on basic information about the aims of it, the board of managers and CEOs, the different bases they have among other material.

Moreover, every worker has to pass another course called "RFDS Drug and Alcohol Management Plan (DAMP)" where all the good practices about these products are expected to be followed by employees and how random samples can be demand by employers or by CASA (Civil Aviation Safety Authority).

All the personnel has to have printed copies of the certificate of these courses to start the job.

Course Version: 1

Royal Flying Doctor Service
SOUTH EASTERN SECTION

Royal Flying Doctor Service South Eastern Section Induction Certificate

Name: Irene Cabanes Batalle **Company Name:** Royal Flying Doctor Service South Eastern Section

Induction Score for Royal Flying Doctor Service South Eastern Section General Induction is 94.44%

ACKNOWLEDGEMENT - I acknowledge that I have personally read and understood the induction, successfully answered the questionnaire and agree to abide by all the requirements outlined in the induction.

Signed: _____

Date: _____

This Certificate is valid until: 16 Feb 2017

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FIGURE 2: EXAMPLE OF THE INDUCTION CERTIFICATE ALL THE PROFESSIONALS MUST HAVE

2.2.1 Health professionals selection process

As the operations of *Royal Flying Doctor Service* are quite "special" in terms of that nurses or doctors have to be multi-task and have general knowledge of many of the specialities, as they are usually on their own taking fully responsibility of their actions while looking after a patient, RFDS has a quite strict selection process.

Nurses are required to:

1. Be a registered nurse
2. Be a registered midwife
3. Have 5 years post-graduate experience in an emergency department, casualty triage or high dependency department
4. Others: Have a driver's C license and be able to swim

Doctors are required to:

1. Trained to an intern level at least
2. Have experience if possible in casualty or emergency department

2.2.2 Health professionals training

A normal competency training is required by their profession along with re-currency training to maintain the skills. Moreover, all nurses and doctors are trained in Aviation Emergency Procedures as it is a requirement to be qualified as a flight nurse or doctor. Therefore, all of them have flight attendant standards too.

2.2.3 Health professionals procedure during the flight

Normal medical procedures are practiced during the flight, the same ones as someone would do in a hospital or clinics. The only difference is that health professionals working during the flight have to be aware of the pressure/altitude affecting on a patient health.

A lot of transfers only have the flight nurse on board, so they have to make their own decisions, although during the flight, the flight nurse can always be in contact with the ground,

as there are doctors and specialists via the Operations Centre (ACC) to assist them in flight with medical conditions.

2.3 Health services that RFDS provides

As stated at the begging of this chapter, as Australians living or travelling can face particular difficulties in gaining access to health and medical care, *Royal Flying Doctor Service* tries to fill the gaps on that field providing several services explain in the following paragraphs:

- PRIMARY EVACUATION: The organization provides emergency evacuations for injured or ill people that require medical attention.
- PRIMARY HEALTH CLINICS: Provision of fly-in fly-out GP and nursing to rural communities.
- REMOTE CONSULTATIONS: Also known as 'telehealth consultations', these are the calls to the RFDS from people in isolated areas who ask for medical assistance.
- MEDICAL CHESTS: Facility of pharmaceutical and non-pharmaceutical items.

FIGURE 3: A CARETAKER OF A RFDS MEDICAL CHEST

- RURAL WOMEN'S GP SERVICE: Some regions have limited access to female GPs, so what RFDS tries to do is offer to the population that option.
- MENTAL HEALTH SERVICES IN RURAL & REMOTE AREAS PROGRAM: Includes psychologists, alcohol and drugs counsellor among other kinds of professionals.
- OTHER RFSD SERVICES
    - Inter-hospital transfers

- Clinical training and education
- Oral health services

2.4 Aviation

Although all the human resources specially prepared for this unusual kind of medical operations that the not-for-profit organization has to provide service are one of the best valuable resources it has got; it wouldn't be possible to perform their procedures without the magnificent aeronautic infrastructure that *Royal Flying Doctor Service* has.

From medically prepared aircraft to airstrips and bases that can accommodate severe injured or sick patients, RFDS is ready to solve any problem someone can have.

In this section all the aviation requirements that RFDS has will be detailed as well as the procedure that they follow during their operations.

2.4.1 Aircraft

Royal Flying Doctor Service has currently 63 aircraft, 4 different types of them:

1. BEECHCRAFT KING AIR (29 units)

   This aircraft is powered by two Pratt and Whitney Canada PT6A-42 Turbo-prop engines delivering 850 SHP (634kW) each on Take-off.

   

   FIGURE 4: RFDS KING AIR B200 AIRCRAFT

   The standard aircraft installation allows for a 2 pilot crew, however most of the RFDS operations are single-pilot. In addition to the normal aircraft systems, this one is fitted with an additional battery to provide medical power, a medical oxygen and a suction system and an intercommunications system between the cockpit and the medical staff in the cabin.

   Its cabin is configured to take 2 stretcher patients and 3 normal seats. Its dimensions are 1.38m of width, 5.01m of length and 1.46m high.

FIGURE 5: RFDS PILATUS PC-12 AIRCRAFT

2. PILATUS PC-12 (31 units)

   This aircraft is powered by a single Pratt and Whitney Canada PT6A-67B Turbo-prop engine. The propeller is a Hartzell HC-E4A-3D/E10477K, 4 blades and a diameter of 2.67m.

   The cockpit is configured for a single-pilot operations in all weather conditions, day and nights. Instrumentation includes Enhanced Ground Proximity Warning and aircraft Traffic Advisory systems. Navigation systems include Global Positioning System and the standard equipment to display data from ground-based navigation aids.

   Its cabin is configured to take 2 stretcher patients and 3 normal seats. Its dimensions are 1.52m of width, 4.68m of length and 1.45m high.

FIGURE 6: RFDS CESSNA C208 AIRCRAFT

3. CESSNA C208 (2 units)

   The Cessna C208 is a single-engined turboprop (Pratt and Witnew PT6A). This airplane typically seats 12 people and can take 2 stretcher patients, although the aircraft is not suitable platform due to its relatively slow speed and lack of cabin pressurisation. Most operations are performed as a single-pilot ones.

4. HAWKER 800XP (1 units)

   Also known as 'Rio Tinto Life Flight jet', this aircraft is part of the RFDS fleet thanks to the help of a mining company, Rio Tinto, who contributed $11 million to the project.

   This aircraft is powered by two Honeywell TFE731-5BR turbofan engines.

FIGURE 7: RFDS RIO TINTO LIFE FLIGHT JET

The cockpit is configured for being able to carry 2 pilots. In the cabin, this is the only permanently configured aeromedical jet anywhere in Australia with the capacity to carry 3 stretcher patients and up to 3 clinical staff at once. The cabin is 1.73m high.

2.4.1.1 Delivery of the RFDS aircraft

RFDS manly purchases their airplanes in USA, where they are made. Once they take delivery on an aircraft, it takes about three to four months of changes that are made in Australia to make it suitable for their needs. For example, they can land on dirt runways and reach smaller stations, as well as putting all the medical equipment in the cabin.

As mentioned in the paragraph before, in order to be a ready-to-go RFDS aircraft, the not-for-profit organization has to transform the 'normal' plane into a fully-equipped flying intensive care unit. This can cost more than two million US dollars and need to be done into two stage procedure.

STAGE 1: CONVERSION INTO A FLYING INTENSIVE CARE UNIT

In this first period, the aircraft is modified in order to be ready for emergency retrievals. For example, the landing gear needs to be adapted to allow for take-offs and landings on dirt airstrips, as well as the door, which has to be altered to allow loading of stretcher patients.

Other things that need to be done at this point:

- Providing hygienic surfaces by replacing cabin floor and walls
- Building cabinets
- Installation of personal safety equipment

STAGE 2: MEDICAL FIT-OUT

It involves equipping the interior of the aircraft with medical equipment along with a communication panel to ensure emergency satellite phone calls.

FIGURE 8: PICTURE OF THE INTERIOR OF A RFDS AIRCRAFT

2.4.1.2 Ownership of the RFDS aircraft

The non-profit organization owns the totality of the aircraft they use for their daily operations thanks to the funds they receive for the state and central governments of Australia and private donations.

As the cost is really high, *Royal Flying Doctor Service of Australia* has contracts with third entities to help cover and finance all these costs. For example, Sydney Mascot base has a contract with Ambulance Service of New South Wales (NSW); as part of the contract, they supply aeromedical aircraft, pilots and engineers in order to transfer patients between hospitals in the NSW state.

2.4.1.3 Maintenance of the aircraft

Every 100 to 200 flying hours, each aircraft is required to undergo a thorough maintenance check to ensure safety, and the engines are checked every 1,750 hours as well, and overhauled at 6,000 hours.

The professionals involved in the process of guaranteeing safety are:

- ENGINEERS: They ensure that the aircraft are safe and always ready to fly, as well as well maintained.
- STOREMEN: They manage the purchasing, overhauls and compliance of over 2.9 million Australian dollars' worth of spare parts.
- TECHNICAL RECORDS TEAM: They prepare and do and implement the paper work, for example, they check the documents issued by the *Civil Aviation Safety Authority* (CASA) and make sure the directives are implemented.

- MAINTENANCE CONTROLLER: Person who coordinates the time and the people that carry out the routine checks. He/She also manages engine and propeller changes.
- QUALITY ASSURANCE OFFICER: Person that ensures a continuous maintenance of the aircrafts.

2.4.2 Runways[1]

The airstrips that *Royal Flying Doctor Service* use are usually very simple, but as all the others, these ones have to have minimum requirements which the *Civil Aviation Safety Authority* (CASA) of Australia set.

As each RFDS division operates slightly different, there are small differences on those requirements, although the general ones can be found in CAAP 92-1 (1) Guidelines for Aeroplane Landing Areas.

2.4.2.1 Airstrip requirements

In the following list can be found the key requirements for the runways that RFDS use:

- Runway size: 1200 meters of length and a minimum width of 90 metres.
  - * If only day operations are done, the width can be reduced to 45 metres.
  - ** The over-flown areas at the ends of the runway must be clear of any obstacles, such as trees and power lines.
- Runway direction: It should be aligned with the prevailing wind direction.
- Centre of the runway (20 metres) must be a firm smooth surface.
- Edge of the runway: The area each side out to 22.5 metres from the runway centre-line need to be cleared to ensure minimal damage to the aircraft.

[1] This section is filled up with the information from the CAAP 92-1 (1) and the Airstrip standards & Reporting Arrangements documents.

- * The remaining area outside those 22.5 metres should be free of tree stumps, large rocks, fencing, wire and any other obstacles above ground, as well as drains below the ground level.

- Parking: A parking apron should be built to avoid interruption other possible operations along the runway.
- Objects required: A windsock is a must-have to indicate the wind strength and direction, and should be located adjacent to the parking apron. Standard wind indicator sleeve dimensions and suitable mast assemblies for daylight operations are shown in the diagram.
- Lighting: Lighting of the runway, taxiways, parking apron and windsock is required for night operation

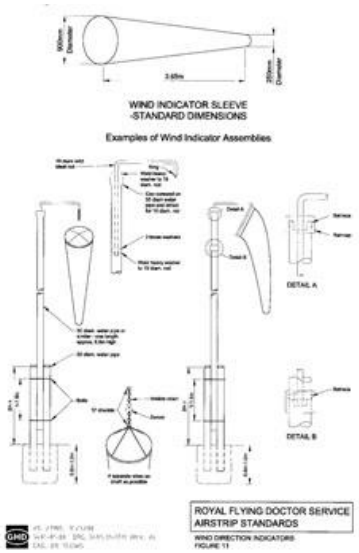

FIGURE 9: STANDARD WINDSOCK DIMENSIONS

- Floor marks: The runway strip, apron, and taxiways need to be marked (all in white). In the following diagrams it is detailed the requirements of Runway Strip Boundary Markers and Runway Edge and Corner Markers.

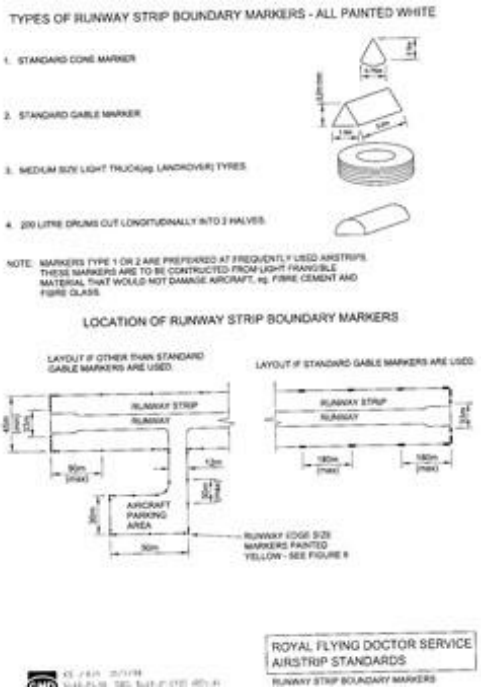

FIGURE 11: TYPES OF RUNWAY STRIP BOUNDARY MARKERS

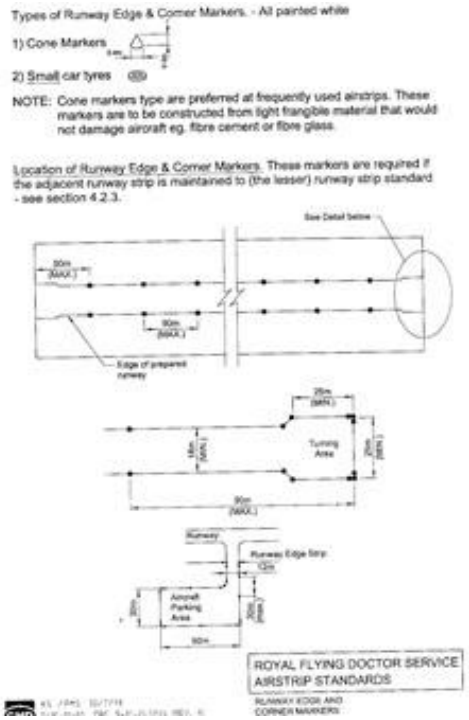

FIGURE 10: TYPES OF RUNWAY EDGE & CORNER MARKERS

2.4.2.2 Airstrip site selection

Although in the Australian outback is difficult to achieve, RFDS has a description of good site selection, basically soil composition and drainage.

NATURAL SURFACE RUNWAY STRIP:

- Aim for areas that are naturally well drained
- Aim for areas without recurrent surface undulations. Preferably there should be a slight camber and a fall along the length of the airstrip.
- Aim for sites whose soil remain compact and smooth when used.
- AVOID: Rock terrain, very sandy soils (the Australian outback is all about sand), and slippery soils when wet.

SEEK FOR:

- A site where there are no hills or buildings more than 45 metres above the airstrip elevation exist within 2500 metres at least.
- A site where there are no residential areas close to it.
- A site which has enough room for accommodating the requirements of the runway strip dimensions.
- A site which can be reachable to normal transport (cars).

2.4.2.3 Airstrip construction

If a new runway strip is to be constructed, all the following requirements need to be followed:

1. DIMENSIONS: The dimensions of the airstrip are mentioned in the section '2.4.2.1 Airstrip requirements'.
2. SURFACE SLOPES

   The maximum allowable longitudinal slope between runway ends is 2%; and should be taken in mind that the longitudinal slope along any portion of the runway is not to exceed 2.68%.

The transverse slope across the runway should not exceed 2.5%.

3. PARKING APRON AREAS

   The dimensions of an apron area should be not less than 50 metres long by 30 metres wide.

4. TAXIWAYS

   The minimum taxiway width is 12 metres.

5. FENCING

   It is preferable that strip are completely fenced to prevent livestock and wild animals, very common in the Australian outback, from wandering onto the surface during landing or take off. If the airstrip is not fenced, clearing of the strip and surrounding area is essential.

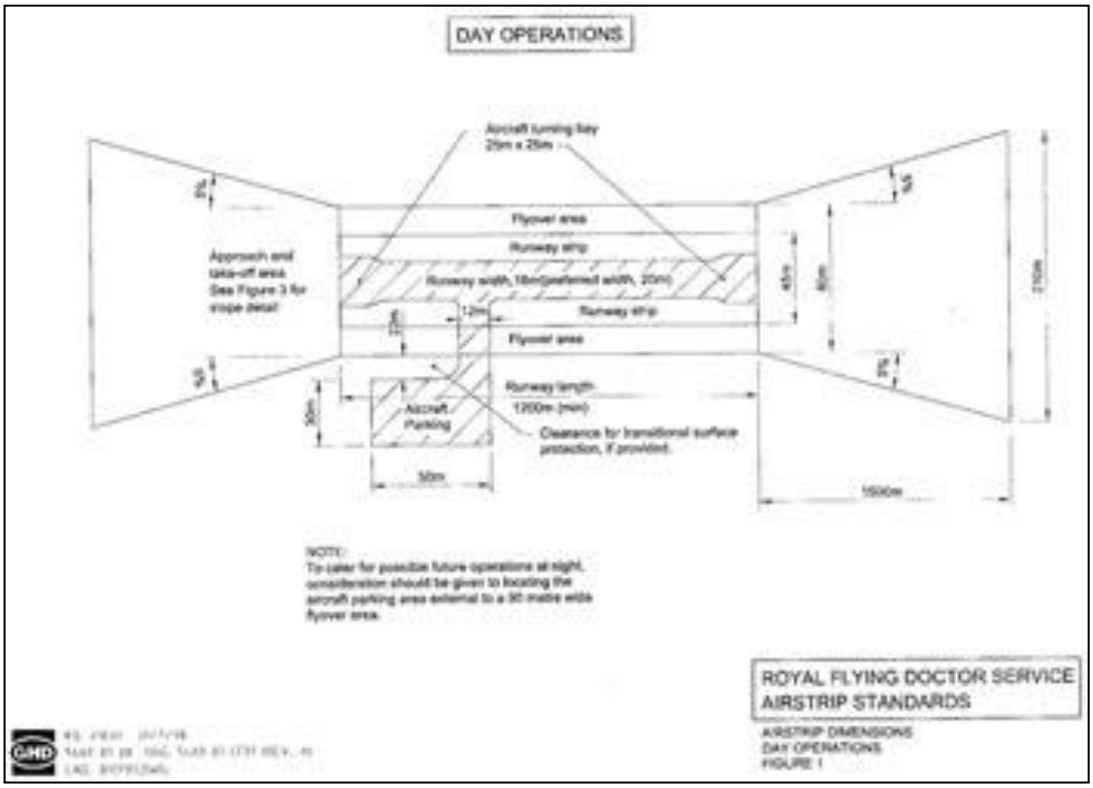

FIGURE 12: DIMENSIONS OF A STANDARD AIRSTRIP IF ONLY DAY OPERATIONS ARE PERFORMED

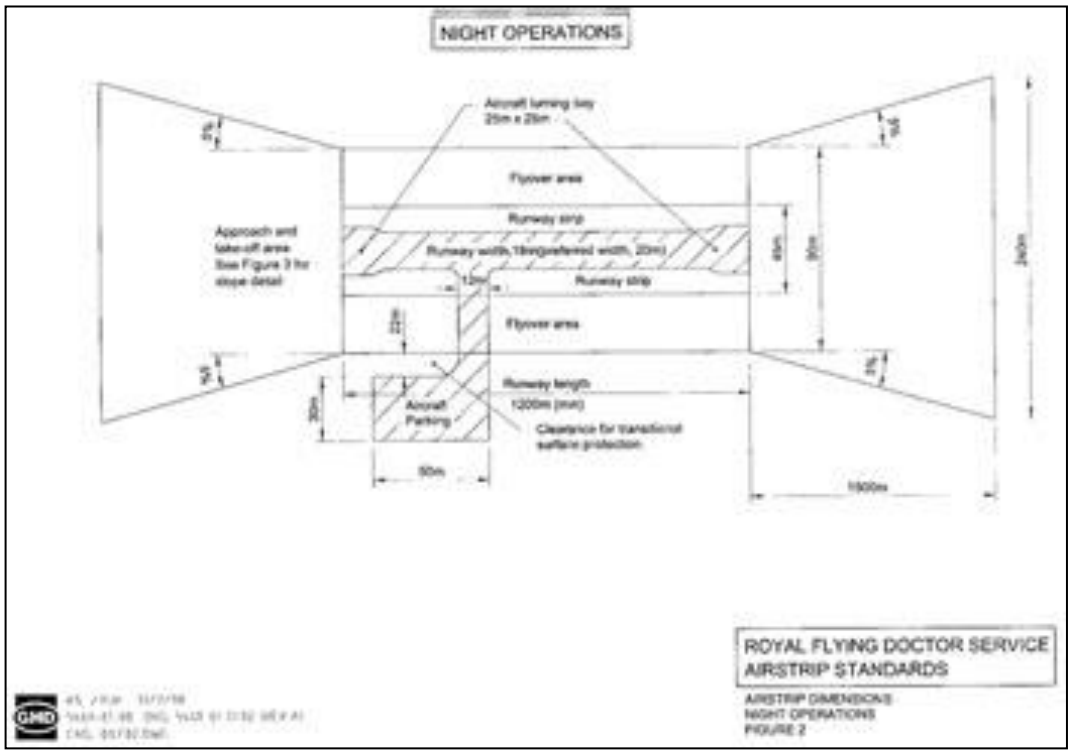

FIGURE 13: DIMENSIONS OF A STANDARD AIRSTRIP IF NIGHT OPERATIONS ARE PERFORMED

2.4.2.4 Airstrip maintenance

As RFDS flies into isolated places across Australia, the runway maintenance facilities and staff that usually can be found in cities are not available. In consequence, the not-for-profit organization relies on people in those remote areas to maintain the standards required for the airstrips safety, so the airstrips are either maintained by:

1. Local Council
2. Property owner
3. Local community

2.4.2.5 Airstrip lighting

The airstrip lights should have a visible range of at least 5km in clear weather in all directions. Moreover, it has to have a minimum stated vertical divergence of at least 10 degree above the horizon.

2.4.3 Bases

By the end of the Australian financial year of 2014 (June), the body had 22 bases spread around the different states of Australia. Those bases cover the 90% of Australia's territory.

FIGURE 14: MAP OF THE RFDS BASES AROUND AUSTRALIA AND SOME OF THE PATHS THEY FLY

All the bases operates 24 hours a day, 365 days a year, so for them there is no Christmas or Easter period to stop them for being at people's service. Although all the bases have some facilities for doctors, nurses and pilots to stay while they wait for being called, some of the professionals might be not on base but on call (maximum half an hour away from it); that's the case of Dubbo and Broken Hill bases in the South Eastern section.

2.4.3.1 Base facilities

Although all the RFDS base are different due to the location and the space they have got in the area, they all have some similar facilities in a hangar, which are:

- FOR ADMINISTRATION
    - Manager office: The base manager has always a private office for its own, due to the hierarchy.
    - Conference room: A conference room is always a must have in case some meetings have to be celebrated in that building.
    - Administration office: This office is where the admin staff do their job. Basically, they are the ones that prepare meetings, courses, pay the salaries to the employees, among other activities.
- FOR ENGINEERS
    - Engineers' room: This room offer to engineers the possibility to look at the manuals of the aircraft, write down the technical changes they do in aircraft,

the current *Civil Aviation Safety Authority (CASA)* regulations and storage the necessary tools.

- Spare pieces room: Here is where engineers found the pieces they need in case to repair an engine or another piece of an aircraft.

❖ FOR PILOTS

- Flight information room: It can be found a screen with all the scheduled flights, the ones currently in the air, the shifts they are doing, and also the information of each of the aircraft they have in the base.
- On-call apartment: Separated from the main building, a mini-apartment can be found for the on-call pilots. They have a kitchen, bedrooms a lounge area and a flight planning room, with all the tools and maps they need.

❖ FOR HEALTH CARERS

- Medical equipment room: All the medical tools needed are stored in this room. It can be found oxygen, pre-natal equipment, etc.
- Nurses' room: It's the place where flight nurses have their paperwork and an area to wait until needed.
- Doctors' office: Doctors have their own space, but very similar to the nurses' room

❖ FOR PATIENTS

- Waiting room: When a patient arrives to the base, until the plane is not ready to leave, he/she waits in a room that looks like one it can be found in a hospital.

❖ FOR VEHICLES

- Aircraft parking area: This area is where planes sleep during night and where engineers work repairing or doing safety checks to them during the day.
- Ambulance parking: It is where ambulances drop off patients or pick them up after a flight.

- Ground handling vehicle parking: This area is where the ground services are, where they wait until they can go and do the check-ups to the aircraft and get them ready for the next flight.

❖ OTHER EXTRAS

- Other bases, such as Dubbo and Broken Hill (both located in New South Wales), have visitor centres, so other educational facilities are required, such as class rooms, plane simulators, gift shops, etc.
- The clinics services are offered daily in different remote areas, where specialist fly from Sydney Mascot base. The consultations are done at public buildings, for example, in local councils.

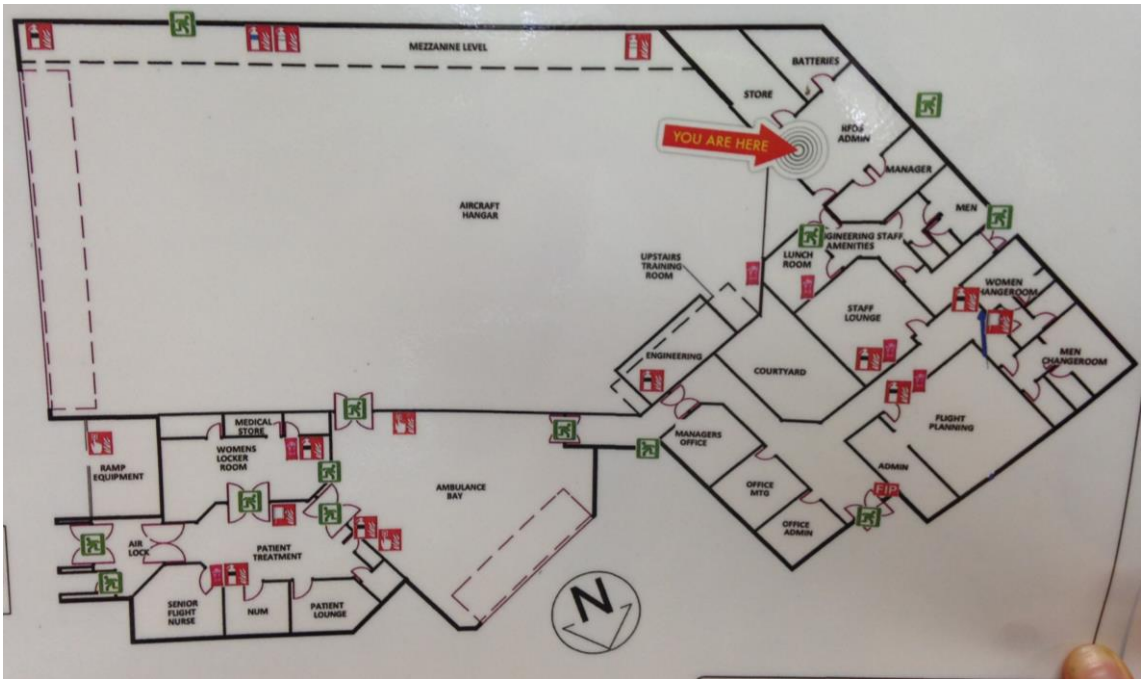

FIGURE 15: EXAMPLE OF THE CONFIGURATION OF A RFDS BASE. (SYDNEY MASCOT BASE)

2.4.3.2 Kind of RFDS bases

The *Royal Flying Doctor Service* organization has prepared all their bases to be emergency respondent, but still two different type of bases can be found depending on what they are specialised for:

✓ EMERGENCY CALLS

The most frequent operations of this kind of base is to respond to all the emergencies they are called for. Usually these are small bases where fewer people work, pilots and flight nurses of course but fewer administration and engineering staff.

- ✓ SCHEDULED-PATIENT TRANSFERS

  Usually, as the big Australian cities is where the best and bigger hospitals can be found, most of the remote little clinics critical patients need to be moved along with patients that need to have a scheduled operation. In conclusion, these bases do scheduled flights picking up patients from remote bases to big cities and vice versa when they can return home.

*EDUCATIONAL CENTERS

Some of the bases that are spread around Australia are also educational centres, either for students, tourists or other kind of visitors, although it's not their main operations, as all of them work as emergency respondent centres too.

2.4.3.3 RFDS base resources

The not-for-profit organization has a total of 63 aircrafts at the moment. As Jenna Brown who is the administration officer of the Sydney Mascot base stated, there are between 2 and 6 aircrafts per base; for example, the base that she is established has 5 (three B350 and two B200) as it's a very busy base where at least they have three flights per day.

In terms of human resources, there are five main roles that can be found:

- Engineers: A Senior Base Engineer (AUD 61,056 per year), Handyperson (AUD 39,792 per year)
- Pilots: Pilot (from AUD 70,700 to AUD 99,000 per year)
- Nurses: Flight nurse (AUD 107,422 per year), Clinic nurse (AUD 85,560per year)
- Administration staff (AUD 41,000 per year)
- Medical officers (AUD 201,185 per year)

The demanding bases as it could be the ones in cities where big hospitals can be found are the ones that have more professionals working in it. It can be about 20 engineers, 30 pilots, 5 ground handlers, 3 administration staff, and 20 flight nurses working different shifts.

In a small base it changes though, taking data from the Dubbo base as a reference, 2 engineers are required (they only do daily maintenance), 3 pilots, no ground handlers, 2 administration staff, and 3 flight nurses.

2.5 RFDS operational procedure

In this section it is going to be described the operational model that *Royal Flying Doctor Service* uses when they are doing their job of flying patients or doctors from one point to another. The procedures vary depending whether it is an emergency procedure or a scheduled patient transfer.

2.5.1 Emergency procedure

This RFDS procedure is constituted by four parts or steps:

- STEP 1: CONTACTING NORMAL EMERGENCY SERVICES
  - 1.1 PATIENT CALLS 000

    The process starts when a patient or someone with the person ill or injured calls the Emergency Services (ES) to alert them from an accident or sickness and their location.
  - 1.2 000 CALLS AN AMBULANCE

    The ES identified that the call is an enough important one to call an ambulance to the place where the patient is and explore him/her.
  - 1.3 AMBULANCE MAKES AN ASSESMENT

    The professionals in the ambulance diagnose the patient as a severe emergency important enough to call the 'flying doctors'.

- ❖ STEP 2: GETTING READY FOR THE EMERGENCY
  - 2.1 CALL TO ROYAL FLYING DOCTOR SERVICE

    After an assessment made for health professionals in the place where the patient is and determined the necessity to contact the RFDS, the not-for-profit organization activates the "medi-evac" status (medical evacuation), the informal word used within the people working in RFDS.

  - 2.2 FLYING DOCTOR CALLS PILOT AND NURSE FOR MISSION

    After determining the closest base with an aircraft available at that time, their call centre informs the base of the operation of the emergency, and therefore a pilot and a nurse on call are called for the mission.

  - 2.3 PILOT PREPARES THE AIRCRAFT

    After a pilot is called for a job, as given the medi-evac status, he or she has 30 minutes before the aircraft has to take off.

    Outsourced from the confidential operational manuals but with the permission of the Flight Operational Manager, basically, the pilot procedure that needed to be followed is the following one:

    - Check the weather (to see if they can get into the airport)
    - Check with Flight Nurse to ascertain engine start time
    - Retrieval Team/NETS details and patient Weights must be obtained
    - Check with engineering aircraft availability and serviceability
    - Flight plan using NAIPS/Champagne Flight Planner
    - Complete Load Data sheets
    - Check Aircraft Maintenance Release and associated paperwork
    - Pre-flight the aircraft (check that the daily inspections have been completed and signed off by the duty engineer)
    - Notify the Flight Nurse that aircraft is "ready" and make a note of the "agreed ready time"

- Open the required door for patient loading and remove the stretcher(s) as required
- Assist with patient loading and unloading at the direction of the Flight Nurse
- Ask if there is any patient requirements that could affect the flight (if they are limited to certain altitude)
- Close the Aircraft doors and begin the start procedure when the flight nurse has advised ready
- Complete all unloading and paperwork followed by making a note in regard to all delays and problems associated with the flight on the Flight tasking sheet.

Other things needed to be taken into account while preparing for the flight are:

- Whether there is fuel available at the airports
- If they need to carry some more extra fuel
- If any airports are not available
- How much fuel they can take out of the base as well.

- 2.4 NURSE PREPARES THE AIRCRAFT

The routine of a flight nurse before they take-off is the following one:

- Go to the nerve centre and sign on
- Check your net job (paper files will be on the fax)
- Hand over the patient (talk with the origin hospital)
- Speak to the pilot and explain the case and possible restrictions
- Grab the flight nurse bag and kit
- Prepare the medical equipment: pumps and drugs required

- Go to the waiting room and introduce him/herself to the patient
- Load the patient in the aircraft

- 2.5 DOCTOR PREPARES PAPERWORK

  The call centre prepares all the paperwork that involves getting an ambulance ready for the patient when he or she arrives to the destination base and therefore the hospital the patient will stay in.

❖ STEP 3: FLYING TO THE EMERGENCY

- 3.1 TAKE-OFF TO THE CLOSEST STRIP

  When the aircrafts departs from the base due to a medi-evac status, the Air Traffic Control (ATC) can move every other aircraft aside to let the RFDS aircraft first. Also, this specific status get direct tracking to wherever they need to go, otherwise they use the same commercial routes.

  Once they are in the air, the RFDS planes can fly anywhere from normally Flight Level 120 (12,000 feet) to 28,000 ft. It all depends on how far they are travelling and see if there is any patient requirements, as sometimes the patient requires that they have a sea level cabin, in consequence, they are only allowed to go to a certain altitude.

- 3.2 ARRIVAL AND RETURN TO THE BASE

  Once they have arrived in the pickup patient airstrip, the flight nurse with the help of other health professional gets the patient on the plane (either seated or in a stretcher position) and drop-off again to the next base where the best hospital for this person is located.

  The same medi-evac air privileges while flying are applied by ATC.

- 3.3 AMBULANCE PICK UP THE PATIENT

An ambulance always waits for the patient in the destination base to transport the patient to the hospital. If it's not the origin base of the aircraft, the pilot and the flight nurse return to the origin point, this time with no air privileges.

- STEP 4: POST OPERATION PROCEDURE
  - 4.1 PILOT POST FLIGHT

    As stated in the operational manual, on return after a flight the pilot must ensure the aircraft is secured and set up for the next pilot. These actions include, but are not limited to:

    1. Placing control locks in the aircraft controls
    2. Returning all navigation equipment to its original state for the next pilot to use.
    3. Assisting flight nurses in returning the aircraft litters back on the aircraft as required.
    4. Ensuring all lights in the cockpit and cabin are switched off so as not to drain aircraft batteries.
    5. Ensuring cargo and/or air stair doors are closes as required.
    6. Placing the propeller ties back on to ensure windmilling of propellers does not occur, which may result in damage.
    7. Leaving a fuel request slip in the propeller ties for ground handler to assist in refuelling.
    8. Ensuring the flight manifest and maintenance log is correct and complete with the folder remaining in the aircraft for next pilot use.
    9. If overnighting away from base, ensuring all bungs and chocks are in place and the aircraft is locked.
  - 4.2 NURSE AFTER FLIGHT

    The routine of a flight nurse after finishing a job is:

- Put the medical equipment in its place
- Put in the diary treat (upload data)
- Have a break
- Ask a hand over for the next day job (host hospital)

- 4.3 GROUND HANDLING PREPARES AIRCRAFT FOR NEXT OPERATION

  A fixed procedure done by the ground handlers is required to be followed:

  - Push the aircraft into the hangar if there is a patient inside. If not, the aircraft will remain in the outdoors parking area.
  - After the engines are off, put the protectors in the propellers
  - Check the engines' oil
  - Wipe the outside part of the cockpit's screen
  - Check the aircraft oxygen and the aircraft medical oxygen
  - Clean the inside of the aircraft
    - Vacuum the floor
    - Remove the bins
  - Check the hot and cold water bottles
  - Refuel the petrol tanks of the aircraft

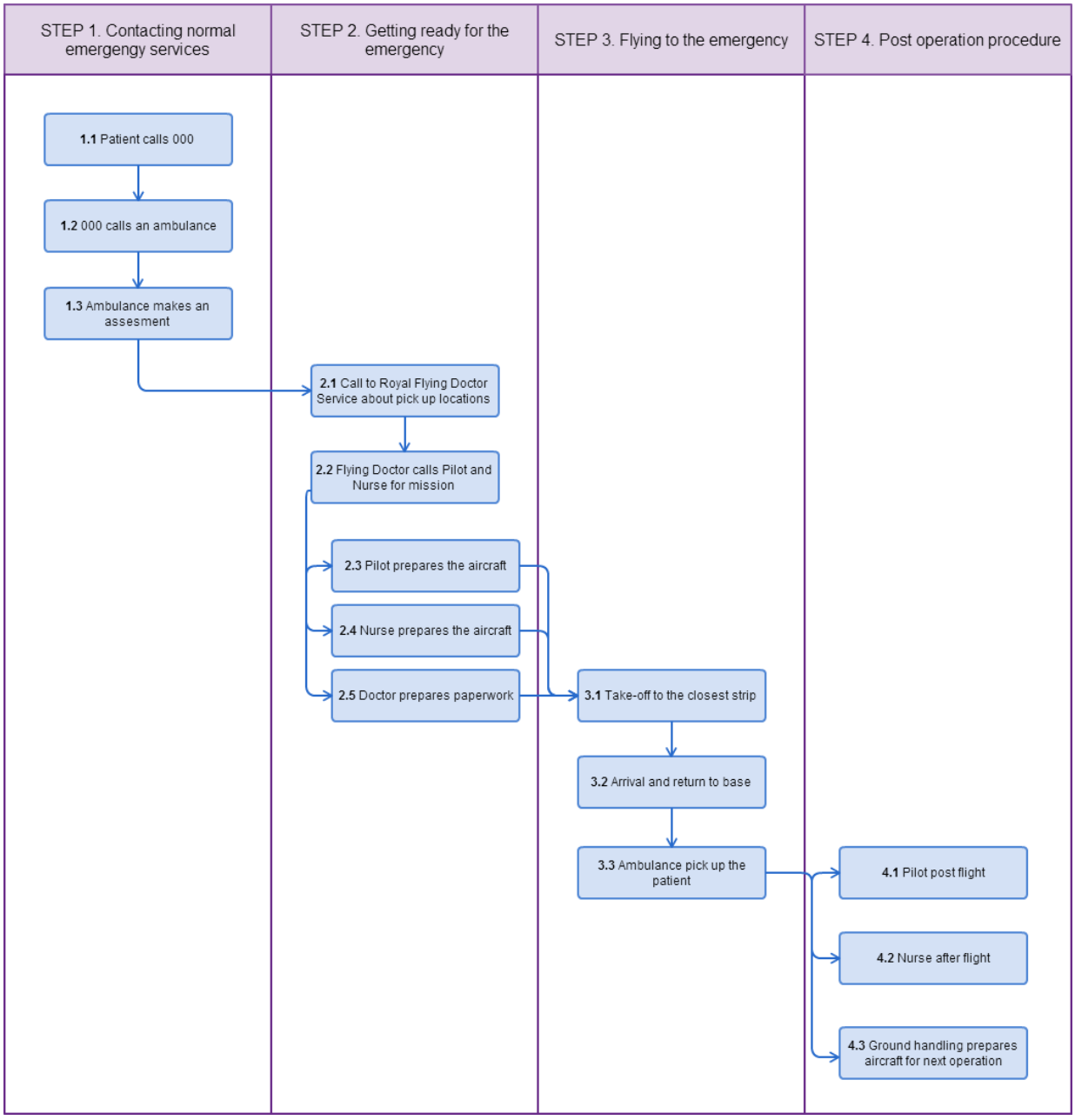

FIGURE 16: DIAGRAM THAT SHOWS THE RFDS PROCEDURE OF AN EMERGENCY

2.5.2 Patient transfer

This second RFDS procedure is constituted by three parts or steps:

- STEP 1: ORGANISING THE TRANSFER
  - 1.1 HOSPITAL RINGS AMBULANCE CONTROL

    The hospital calls the Ambulance Control (AC) to arrange a transfer with the *Royal Flying Doctor Service* from hospital A to hospital B.
  - 1.2 AMBULANCE CONTROL ALLOCATES GROUND AMBULANCE, PILOT & NURSE

    The AC assigns the whole parts of the operation: origin base, departure time, an ambulance from the origin, the pilot and flight nurse that will help during the procedure.

- STEP 2: DAY OF THE TRANSFER
  - 2.1 PILOT PREPARES THE AIRCRAFT

    As the pilot knows with hours or even days of the operation he or she will be involved in, the pilot has 60 minute of preparation before the aircraft has to take off.

    Outsourced from the confidential operational manuals but with the permission of the Flight Operational Manager, basically, the pilot procedure that needed to be followed is the following one:
    - Check the weather (to see if they can get into the airport)
    - Check with Flight Nurse to ascertain engine start time
    - Retrieval Team/NETS details and patient Weights must be obtained
    - Check with engineering aircraft availability and serviceability
    - Flight plan using NAIPS/Champagne Flight Planner
    - Complete Load Data sheets
    - Check Aircraft Maintenance Release and associated paperwork

- Pre-flight the aircraft (check that the daily inspections have been completed and signed off by the duty engineer)
- Notify the Flight Nurse that aircraft is “ready” and make a note of the “agreed ready time”
- Open the required door for patient loading and remove the stretcher(s) as required
- Assist with patient loading and unloading at the direction of the Flight Nurse
- Ask if there is any patient requirements that could affect the flight (if they are limited to certain altitude)
- Close the Aircraft doors and begin the start procedure when the flight nurse has advised ready
- Complete all unloading and paperwork followed by making a note in regard to all delays and problems associated with the flight on the Flight tasking sheet.

Other things needed to be taken into account while preparing for the flight are:

- Whether there is fuel available at the airports
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The routine of a flight nurse before they take-off is the following one:

- Go to the nerve centre and sign on
- Check your net job (paper files will be on the fax)

- Hand over the patient (talk with the origin hospital)
- Speak to the pilot and explain the case and possible restrictions
- Grab the flight nurse bag and kit
- Prepare the medical equipment: pumps and drugs required
- Go to the waiting room and introduce him/herself to the patient
- Load the patient in the aircraft

- 2.3 AICRAFT LAUNCHES

  When the aircrafts departs from the base due to a hospital status, the Air Traffic Control (ATC) gives the aircraft an above normal commute passenger code (status of priority) but nothing like the medi-evac status.

  Once they are in the air, the RFDS planes can fly anywhere from normally Flight Level 120 (12,000 feet) to 28,000 ft. It all depends on how far they are travelling and see if there is any patient requirements, as sometimes the patient requires that they have a sea level cabin, in consequence, they are only allowed to go to a certain altitude.

- 2.4 MEETS AMBULANCE AT THE DESTINATION

  An ambulance always waits for the patient in the destination base to transport the patient to the hospital.

- 2.5 RETURN FLIGHT

  The pilot and the flight nurse return to the origin point with the empty aircraft, this time with no air privileges.

❖ STEP 3: POST OPERATION PROCEDURE

- 3.1 PILOT POST FLIGHT

As stated in the operational manual, on return after a flight the pilot must ensure the aircraft is secured and set up for the next pilot. These actions include, but are not limited to:

1. Placing control locks in the aircraft controls
2. Returning all navigation equipment to its original state for the next pilot to use.
3. Assisting flight nurses in returning the aircraft litters back on the aircraft as required.
4. Ensuring all lights in the cockpit and cabin are switched off so as not to drain aircraft batteries.
5. Ensuring cargo and/or air stair doors are closes as required.
6. Placing the propeller ties back on to ensure windmilling of propellers does not occur, which may result in damage.
7. Leaving a fuel request slip in the propeller ties for ground handler to assist in refuelling.
8. Ensuring the flight manifest and maintenance log is correct and complete with the folder remaining in the aircraft for next pilot use.
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  A fixed procedure done by the ground handlers is required to be followed:

  - Push the aircraft into the hangar if there is a patient inside. If not, the aircraft will remain in the outdoors parking area.
  - After the engines are off, put the protectors in the propellers
  - Check the engines' oil
  - Wipe the outside part of the cockpit's screen
  - Check the aircraft oxygen and the aircraft medical oxygen
  - Clean the inside of the aircraft
    - Vacuum the floor
    - Remove the bins
  - Check the hot and cold water bottles
  - Refuel the petrol tanks of the aircraft

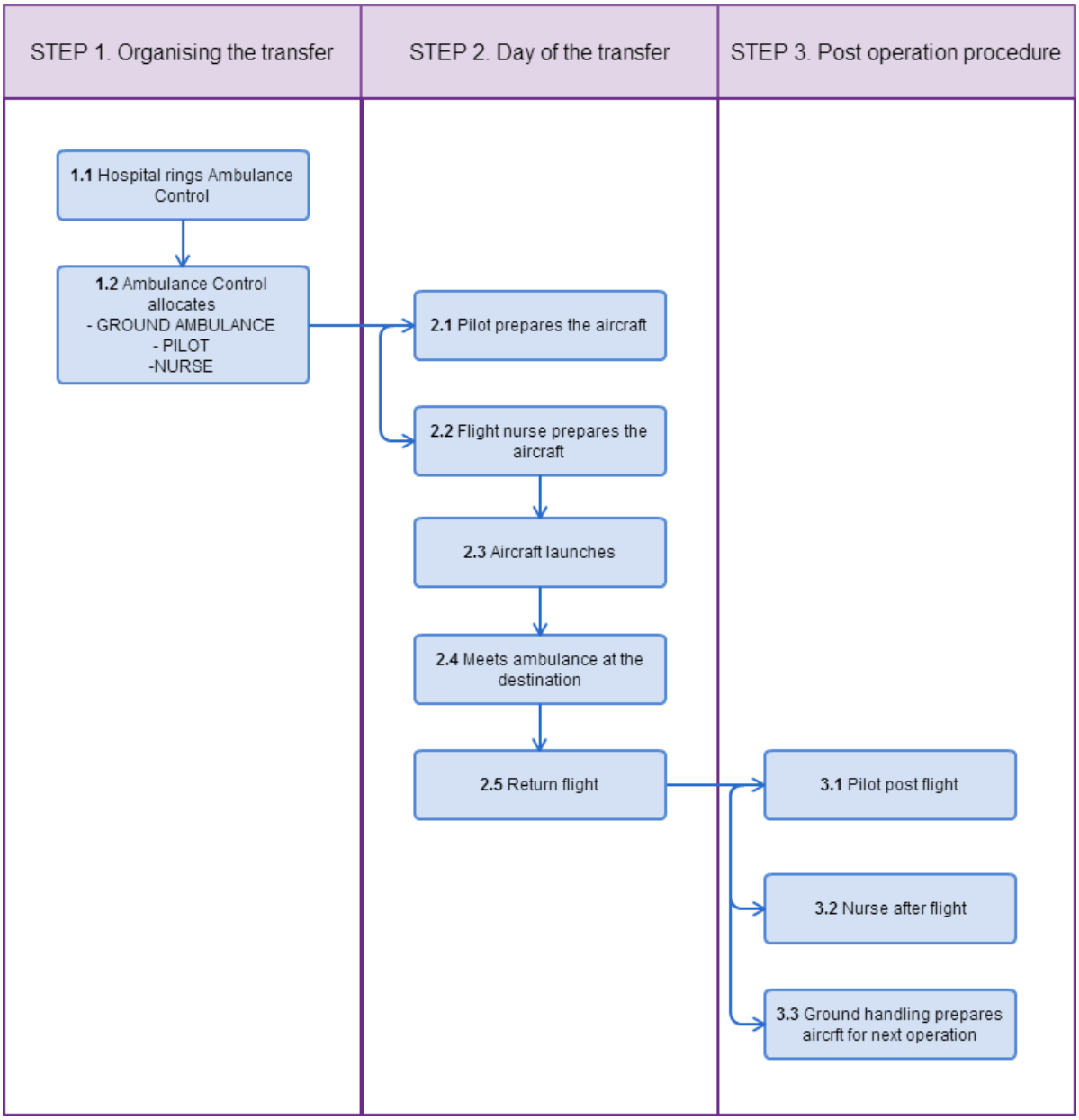

FIGURE 17: DIAGRAM OF THE RFDS SCHEDULED FLIGHT PROCEDURE

2.6 Organizational structure

There are three levels within the global *Royal Flying Doctor Service of Australia* organization:

- RFDS National Office: an overall umbrella that provides administration, policy and global guidelines. It might do lobbying for regulatory form to the government.
- RFDS Sections: independent bodies within the global corporation in the different states of Australia. Each of these sections have their own AOC (Airline Operation Certificate), a chief pilot, a head of engineering and of course a CEO. As you can see, they are quite independent from their peers, they have their own marketing, own fundraisers among others functions.
- RFDS Bases: They follow their Section guidelines and leadership

2.7 Communication within the organization

There are different streams, all of them within a section. There are also two different newsletters, a fortnightly one (only for staff) and a monthly one (for staff and visitors).

The normal corporate type of communications are:

- *Face-to-face weekly meeting with the General Operations Manager and the Base Manager*
- *Face-to-face weekly meeting with the Senior Base Pilot (SBP), the Senior Base Engineer (SBE), Storrs, General Admin and the Base Manager.*
- *Phone hock up weekly meeting with all the Base Managers within a RFDS section and the General Manager of Operations (GMOPS).*
- *Face-to-face every 3 months meeting with all the Base Managers within a RFDS section, the GMOPS, the Chief Pilot, the head of engineering, and the General Manager of Safety and Quality.*
- *SBP writes a fortnightly newsletter*
- *SBE writes a fortnightly report*
- *Normal catch-up with SBP and all the other pilots*

- *Normal catch-up with SBE and all the other engineers*

2.8 External organizations to deal with

External organizations that RFDS has to deal with are:

- AVIATION: CASA, Airport Authorities, Aircraft Suppliers, IATA, ICAO, ISO
- HEALTH: Regional Health Authority, State Health Department, Federal Health Department

CHAPTER III – Applicability of the operations of *Royal Flying Doctor Service* in Spain

In this chapter, all the knowledge gained from the Australian organization will be applied within the Spanish territory. Although the implementation of such a complex system cannot be assured before researching of how the medicalized aviation works in Spain, a first approach through a suggestion on how it could be apply will be done.

3.1 The Spanish aviation industry background

As explained in the *Alas virtuales* blog, the Spanish commercial aviation industry started in 1921, when the first aerial post plane was used, within a company called *Compañía Española de Tráfico Aéreo (CETA)*, not only to transport post but also some passengers. From that time, multiple airlines came to business, such as *Aviaco*, and several regional routes are performed. *Iberia* started being a shareholder of *Aviaco* in 1959, but it is not in 1999 when *Aviaco* is finally absorbed by *Iberia*. This airline has played an important role in the development of the Spanish aviation, as it was until 2001 the Spanish public airline, when it was privatized. The Schengen agreement also contributed to the development of the industry, as with no air border restrictions, more and more international airlines flew from and to Spain.

For that reason, over the years the country has builded many airports. Spain has currently 46 public airports, 2 public heliports and 4 private airports. As the Fedea report states, only 8 of the public ones are profitable, and more than 20 have an airport at less than an hour by car.

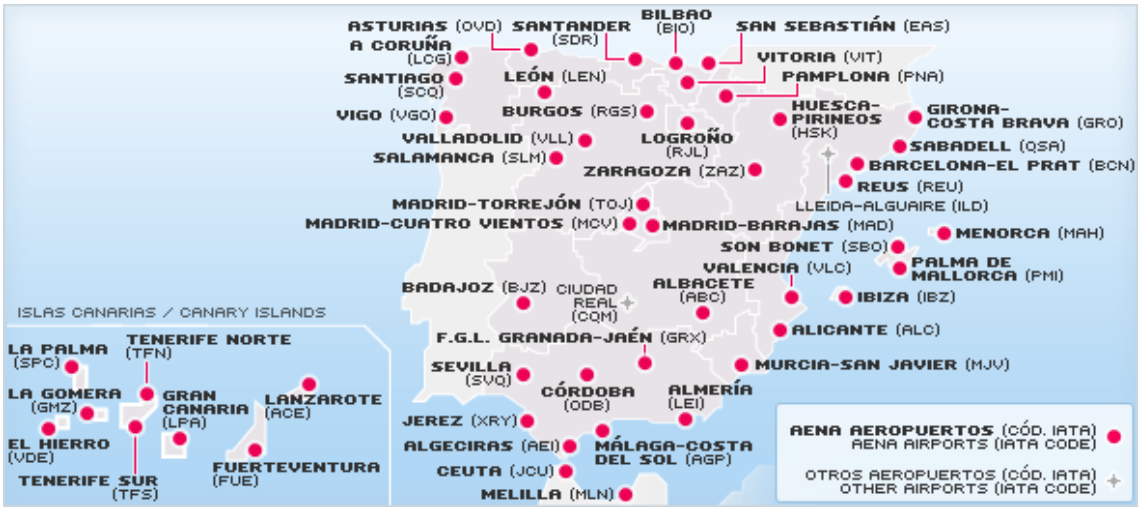

FIGURE 18: MAP WITH ALL SPANISH AIRPORTS

3.2 The Spanish health sector background

Although the health sector includes a variety of services, as RFDS only works basically with hospitals and ambulances services external organizations (because all the clinics are theirs), in this section it will only focus on the research done in both of those services.

3.2.1 Spanish hospital network

Spain is known for its great health system. Nowadays, as the *Ministerio de Sanidad, Servicios Sociales e Igualdad* explains in the 'Hospital National report', Spain has 789 hospitals.

C. AUTÓNOMA	H.PÚBLICOS	H. PRIVADOS	**TOTAL**
Andalucía	47	59	106
Aragón	18	11	29
Ppdo. De Asturias	9	11	20
Islas Baleares	11	11	22
Canarias	14	23	37
Cantabria	4	4	8
Castilla-La Mancha	20	9	29
Castilla y León	16	21	37
Cataluña	55	156	211
Comunidad Valenciana	35	27	62
Extremadura	8	11	19
Galicia	14	24	38
Madrid	34	48	82
Región de Murcia	10	16	26
C. Foral de Navarra	4	7	11
País Vasco	18	26	44
La Rioja	3	3	6
Ceuta	1	0	1
Melilla	1	0	1
Total nacional	322	467	**789**

TABLE 1: NUMBER OF SPANISH HOSPITALS CLASSIFY BY SPANISH AUTONOMOUS COMMUNITIES

As detailed in the table above, most of the hospitals are concentrated in few of the Autonomous Communities rather than uniformly spread. Moreover, when looked into the report held by the *Monitor de Reputación Sanitaria*, it showed that the rankings provided display an evidence that the assistance quality is very different depending on which Spanish region people is treated. In the whole ranking, it is worth mentioning that Madrid has 24 hospitals, Catalonia has 19, Comunidad Valenciana has 11 and finally Andalucía 9.

The top 10 Spanish hospitals are the following ones: La Paz (Madrid), Clínic de Barcelona (Catalonia), Gregorio Marañón (Madrid), Vall d'Hebron (Catalonia), 12 d'Octubre (Madrid), La Fe (C. Valenciana), Ramón y Cajal (Madrid), Virgen del Rocío (Andalucía), Clínico San Carlos (Madrid) and Santa Creu i Sant Pau (Catalonia).

3.2.2 Spanish ambulance network

SAMU is the acronym by which is known the medical urgent care, a dependent service of Public Health for emergency services. In Spain, the SAMU is not based on national standards of the Ministry of Health, because health is now regulated by the regions, the Autonomous Communities.

In most Spanish regions, the name SAMU is not used, it is often recognized by the number of the medical alert specified in each region. There are 17 SAMU, one for each region, plus two for the autonomous cities of Ceuta and Melilla:

- SAMU 061 Ceuta.
- SAMU 061 of Andalusía depend on its Secretary of Health. It is one of the more advanced SAMU 061 of Spain along with the Galicia one.
- SAMU 061 of Aragón, locally called 061 Aragón.
- SAMU 061 of Ppdo. de Asturias.
- SAMU 061 of Islas Baleares.
- SAMU 061 of Cantabria.
- SAMU 061 of Castilla – La Mancha.
- SAMU 061 of Castilla y León.
- SAMU 061 of Catalonia, locally called SEM (Medical Emergency Services).
- SAMU 061 of Galicia.
- SAMU 112 of Madrid, which is composed by two organisms: SAMUR (Rescue and Urgency Municipal Assistance Service) for the city of Madrid and SUMMA 112 (the old 061), which is a similar entity but for the whole Autonomous Community.

- SAMU 061 of Región de Murcia.
- SAMU 112 of C. Floral de Navarra.
- SAMU 112 de C. Valenciana.
- SAMU 061 of País Vasco.
- SAMU 061 of Melilla

3.2.3 ONT: *Organización Nacional de Transplantes*

The ONT is the Spanish transplant organization that coordinates organ, tissue and cells procurement and clinical usage within the Spanish regions, which mission is the promotion of the altruistic donation of Spanish citizens to help their compatriots. The organism structure is based on three levels, which are National Coordination, Autonomic Coordination and Hospital Coordination.

Although during the 60s the first transplants operations were made in Spain, they didn't have any legal regulation. To continue with the development of these practices, the transplant laws "Ley 30/1979" and "Real Decreto 426/1980" were introduced during the 1980. The ONT was created in 1989, and the "Hospital del Rey" specialized in infectious illnesses was the selected location to place it, which meant the start of activity of this organism. During the 80s, the ONT used to coordinate donors and transplant operations within the same city, but after an agreement with the Spanish Air Force, they offered long-haul services too.

Nowadays, the "Spanish model" of transplant organization is known and implemented worldwide, which consists mainly in putting coordinators in all hospitals. The basic points that define this model are:

- ❖ The web of transplant coordinators in the previous stated three levels within Spain.
- ❖ The high participation of transplant specialists that collaborate intensively with the coordinators.
- ❖ The quality program in the organ donation process.

- The ONT central office acts as a service agency that supports the whole system. Its functions are the organ distribution, the transport organization, the management of the waiting lists and the statistics.
- The continuous formation for all the workers involved in the transplant process.
- The funding provided from the Autonomous Communities.
- The dedication provided to the media with the objective to improve the knowledge of the population.
- An appropriate legislation.

Regarding the current method of transport that the ONT uses for the organ's transport, it has basically two ways of doing it: using private airplanes and using commercial airplanes. First of all, the first operation with private airplane transport was done in May 1990, as, as previously explained, all the operations used to be done in collaboration with the Spanish Air Force. Since then, more than 3,500 air transports have been coordinated from the ONT. The second option, sending organs in commercial regular flights, has been used since 2001. The collaboration with Iberia meant the agreement between those two organizations to cooperate and they defined the procedure of the organ fridges through regular flights. In 2007, there were 137 organs that thanks to that contract could be send to a long-distance hospital and they were successfully transplanted. More recently, ONT has confirmed that more contracts with airlines that also have regular services within Spain exist, although has not detailed which ones they are.

3.3 Reasons for studying the implementation of the RFDS model

The Spanish Health System is regularly ranked among the best in the world, guaranteeing universal coverage and no upfront expenditure from patients apart from paying a proportion of prescriptions charges. Therefore the Spanish system is a valid one which already works for the population. But if some improvements had to be made, the RFDS model system could help Spanish healthcare system increase the response time in critical health procedures. This study will focus on:

- ✓ Long-distance transfer of patient into specialized hospitals
- ✓ Urgent transfer of patients or organs for transplant purposes

In this two areas, the RFDS model could contribute with time efficiency procedures which are very important in transplant events as every second counts; time is a huge factor which determines the failure or the success of the whole operation.

3.4 Suggested RFDS model implementation procedure

In order to proceed with the applicability of the RFDS model, a suggested implementation route will be introduced:

- STEP 1: Analyse Spanish transplant statistic data in order to identify the main transplant focuses (cities) in Spain, both the generation and the destination areas. This includes the search of the main hospitals which do the transplant operations.
- STEP 2: Make a summary table of the exchange movements between Autonomous Communities.
- STEP 3: Research the most suitable airports to put bases.
- STEP 4: Decide the type of aircraft to be used.
- STEP 5: Make a budget for the implementation

3.4.1 Step 1: Spanish transplant statistic data analysis

The Spanish transplant statistic data is supported by its national transplant organization, the ONT. Each year, this body provides a data memory of public access, which is full of information, figures and tables that give evidence of the transplants procedures in Spain.

3.4.1.1 Spanish donors

During 2013, there were registered 1655 solid organ donors in Spain, which gives Spain a per million of population index (pmp) of 35,1. From those 1655 donors, 200 of them couldn't finally use their organs, which left a number of 1455 of effective donation (30,9pmp) and a number of 4279 of solid organ transplants done.

In the following maps, the distribution of the donation index can be seen for the 17 Autonomous Communities that form Spain, extracted from the Spanish national transplant organization:

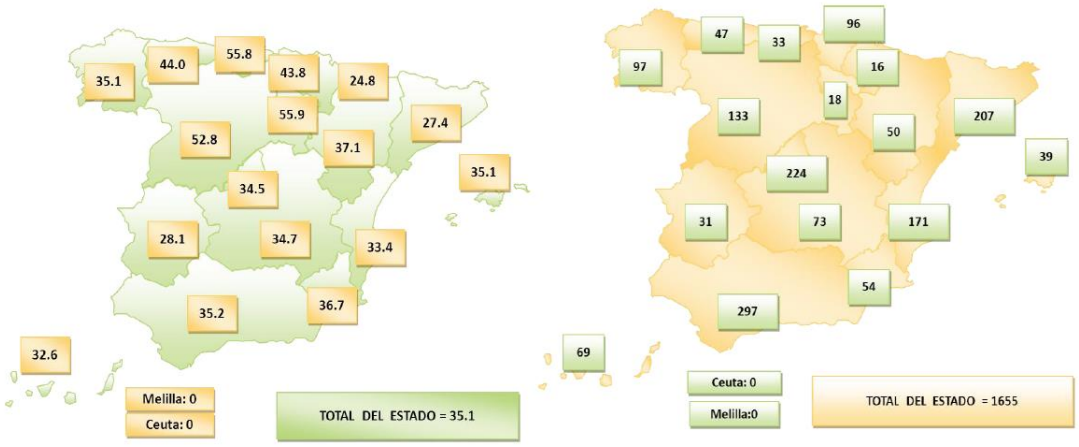

FIGURE 19: SPAIN MAPS WHICH SHOW THE PMP DONORS TAX AND THE REAL NUMBER OF DONORS

Using the maps, it can be concluded that apart from Ceuta and Melilla, all the other Autonomous Communities (AC) have donors, which would lead to the conclusion that it would be worth for all AC to have a base in the area in order to secure that the organ or the donor be can be transported to its destination as quick as possible.

3.4.1.2 Cardiac transplants

Spanish National Transplant Organization (ONT) consider cardiac transplants as a routine and consolidated therapy in within the Spanish hospital network. During 2013, 249 transplants were made, a cardiac transplant activity of 5,3 pmp. In the following table, an evolution of the cardiac transplants can be seen within the Autonomous Communities:

Relación de Trasplantes Cardiacos								
CC.AA.	Hospital	2010		2011		2012		2013	
		Total	(Inf)	Total	(Inf)	Total	(Inf)	Total	(Inf)
Andalucía	H. Reina Sofía	12	(3)	21	(1)	15		12	(2)
	H. Virgen del Rocío	14		17		17		15	
Aragón	H. Miguel Servet	9		7		11		8	
Asturias	H. Central de Asturias	13		11		16		14	
Cantabria	H. M. de Valdecilla	16		16		20		25	
Castilla y León	H. Clínico .Valladolid	8		5		5		4	
Cataluña	H. de la Sta Creu i St. Pau	14		17		13		14	
	H.de Bellvitge	15		19		18		14	
	H. Clinic i Provincial	11		11		18		19	
	H. Infantil Vall d´Hebrón	3	(3)	7	(7)	3	(3)	5	(5)
Com. Valenciana	H. La Fé	32		31		26		22	
Galicia	H. Universitario de A Coruña	23	(3)	18	(3)	25	(2)	20	(3)
Madrid	H. Gregorio Marañón	16	(2)	21	(5)	17	(6)	24	(14)
	H. Puerta de Hierro	16		13		20		16	
	H. Doce de Octubre	19	(1)	14		15		16	
	H. Infantil La Paz	6	(5)	1	(1)	2	(2)	6	(6)
Murcia	H. Virgen de la Arrixaca	6		3		1		7	
Navarra	Clínica Univ. Navarra	10		5		5		8	
	Total del Estado	243	(17)	237	(17)	247	(13)	249	(30)
Incluidos Trasplantes cardiopulmonares									
( ) Trasplantes Infantiles < 16 años									

TABLE 2: DISTRIBUTION OF THE CARDIAC TRANSPLANTS DONE IN SPAIN WITHIN THE YEARS 2010 - 2013

It is important to highlight that Table 2 points out the main hospitals involved in cardiac transplants, which will be useful in the final part of the Step 1, to decide the main area in which a base similar to the RFDS one should be placed.

Moreover, the following table shows the cardiac exchange within Autonomous Communities. Table 3 will help to decide the size of the base infrastructures, depending whether there is or not a lot of activity in that community.

INTERCAMBIO CARDIACO ENTRE COMUNIDADES AUTÓNOMAS. AÑO 2013 (Órganos Implantados)

GENERACIÓN CARDIACA

CC.AA IMPLANTE	GALICIA	ASTURIAS	CANTABRIA	PAIS VASCO	NAVARRA	ARAGÓN	LA RIOJA	CATALUÑA	BALEARES	COM.VALENCIANA	MURCIA	CASTILLA Y LEÓN	CASTILLA-LA MANCHA	EXTREMADURA	MADRID	ANDALUCÍA	Ciudad A.de Ceuta	Ciudad A.de Melilla	CANARIAS	EUROPA	Recibe de fuera de la CA	
GALICIA			1	3				2		1				1	1	1				2	12	Portugal-2
ASTURIAS	1			2				1		1					1	2					8	
CANTABRIA	3	3		9		2		2				1	1		1						22	
NAVARRA	1	2						1		1					1	1					7	
ARAGÓN		1		3									1		1						6	
CATALUÑA				5					5	6	1	4	1		5	3				1	31	Portugal-1
COM.VALENCIANA	3			1				2			1	1	1								9	
MURCIA										1					1	2					4	
CASTILLA Y LEÓN									1	1											2	
MADRID	2	1		4	2	2		8	2	6		6	3	1		8			1	1	47	FR-1
ANDALUCÍA	1	1		1								4		2	4				1		14	
EUROPA										1												1
Envía fuera de la CA	11	8	1	28	2	4	0	16	8	18	2	16	7	4	15	17	0	0	2		159	162 Envía a Europa
										FR-1										4		Recibe de Europa

TABLE 3: CARDIAC EXHANGE WITHIN SPANISH AUTONOMOUS COMMUNITIES

3.4.1.3 Bowel transplants

In terms of bowel transplants, there have been transplanted 8 in Spain during the year 2013. In the following graphic, an evolution of the bowel transplant activity in absolute numbers can be seen. As it can be seen, this kind of transplant is done in very few hospitals, which are H. Vall d'Hebrón (Catalunya), H. Doce de Octubre (Madrid), H. Infantil La Paz (Madrid) and H. Ramón y Cajal (Madrid).

Despite the low number of bowel transplants, it is significant to explain that there is a higher number of bowel transplant in combination of other organ transplants (bowel and liver, heart and lungs, and heart and bowel) which are not counted as bowel transplants. The combined transplant is an activity which numbers have increased in recent years to give answer to the patients who have a simultaneous organ failure. Table 4 shows the Spanish combined transplants that were made in 2013:

Tabla 8.II. Trasplantes combinados año 2013			
HOSPITAL	Hígado - Riñón	Corazón - Pulmón	Corazón - Riñón
LA PAZ Infantil	1		
H. P.HIERRO	3	1	1
V. ARRIXACA	1		
I. CRISTINA	1		
CLÍNICO ZARAGOZA	1		
LA FE (Alicante)	1	1	1
Gral. ALICANTE	1		
V.HEBRÓN Adultos	2		
CLINIC I PROV.	3		
BELLVITGE	2		
V. ROCÍO	1		
R. MÁLAGA	3		
M. VALDECILLA	1		
C.H.U. A Coruña	1		1
C.H.U. Santiago	2		
H. CRUCES	1		
TOTAL	25	2	3

TABLE 4: COMBINED TRANSPLANTS IN SPAIN AND HOSPITALS WHICH PERFORMED THE OPERATIONS

3.4.1.4 Liver transplants

Nowadays, liver transplants are one of the most performed ones in the world, and Spain numbers show that it is not an exception in this country. According to the World Transplant Register, which was developed thanks to the collaboration of the World Health Organization (WHO) and the National Transplant Organization (ONT), 21.000 liver transplants are performed in the world each year. Spanish performance is very noteworthy, as it does a 5,4% of the world's activity (when Spain only represents the 0,7% of the world's population).

The absolute number of liver transplants done in Spain during 2013 is 1093, which represents an index of 23,2 pmp, beating USA (19,8) for example. Additional 346 livers were not useful and weren't able to be transplanted.

Subsequently, two tables are presented. Table 5 presents the liver transplants during 2013 in the different Autonomous Communities and the hospitals that performed them; Table 6 presents the liver exchange within AC, which as Table 2 will, it will help to decide the size of the base infrastructures.

Relación de Trasplantes Hepáticos							
C.A.	Hospital	2010		2011		2013	
		Total	(Inf)	Total	(Inf)	Total	(Inf)
Andalucía	H. Reina Sofía. Córdoba	48	(8)	68	(10)	54	(10)
	H. Virgen del Rocío. Sevilla	59		55		74	
	H. Regional. Málaga	42		51		40	
	H. Virgen de las Nieves. Granada	19		37		27	
Aragón	H. Clínico Lozano Blesa . Zaragoza	31		30		32	
Asturias	H. Central. Oviedo	28		29		34	
Canarias	H. Ntra.Sra.de la Candelaria.Tenerife	36		40	(1)	36	
Cantabria	H. M. Valdecilla. Santander	17		28		22	
Castilla y León	H. Del Río Hortega. Valladolid	38		47		49	
Cataluña	H. Bellvitge. L'Hospitalet	45		59		57	
	H. Vall d'Hebrón Inf. Barcelona	7	(7)	9	(9)	10	(10)
	H. Vall d'Hebrón .Barcelona	34		46		27	
	H. Clinic i Provincial.Barcelona	72		73		73	
Com. Valenciana	H. La Fe. Valencia	108	(5)	101	(7)	92	(9)
	H. Gral de Alicante					34	
Extremadura	H. infanta Cristina. Badajoz	9		21		30	
Galicia	H. Universitario de A Coruña	42		40		46	
	C.H. Universitario. Santiago	34		40		39	
Madrid	H. Doce de Octubre	60	(1)	72	(7)	66	(4)
	H. Ramón y Cajal	33		42		34	
	H. Gregorio Marañón	44		46		38	
	H. La Paz Infantil	27	(24)	33	(33)	23	(20)
	H .Puerta de Hierro	19		21		28	
Murcia	H.Virgen de la Arrixaca. Murcia	45	(1)	64		42	
Navarra	Clínica Univ. Navarra. Pamplona	17		24		23	
País Vasco	H. Cruces. Bilbao	57		61	(1)	63	
Total del Estado (Infantiles < 16 años)		971	(46)	1137	(68)	1093	(53)
Trasplantes Donante Vivo (Infantiles < 16 años) Incluidos en totales		20	(10)	28	(22)	23	(13)

TABLE 5: LIVER TRANSPLANTS WITHIN SPANISH AUTONOMOUS COMMUNITIES IN 2013

INTERCAMBIO HEPÁTICO ENTRE COMUNIDADES AUTÓNOMAS. AÑO 2013 (Órganos Implantados)																					
	CC.AA GENERACIÓN																				
CC.AA IMPLANTE	GALICIA	ASTURIAS	CANTABRIA	PAÍS VASCO	NAVARRA	ARAGÓN	LA RIOJA	CATALUÑA	BALEARES	COM. VALENCIANA	MURCIA	CASTILLA Y LEÓN	CASTILLA-LA MANCHA	EXTREMADURA	MADRID	ANDALUCÍA	Ciudad A. de Ceuta	Ciudad A. de Melilla	CANARIAS	EUROPA		Total RECIBE	
GALICIA			2	5		1	1		1	2		6	1		1	3			1			24	
ASTURIAS			1	1			1					5			1							9	
CANTABRIA		2		1			4					3			2							12	
PAÍS VASCO		1			2							7										10	
NAVARRA	1						4					9										14	
ARAGÓN	1											1	1									3	
CATALUÑA	2			2	2				20	2	2	4	2		3					1		40	IT-1
COM. VALENCIANA	2				1			2	1			1	2		1	2			1			13	
MURCIA	1								1				6		3	3						14	
CASTILLA Y LEÓN		1		1							1		1		1	2			1			8	
EXTREMADURA						1						1	7			1						10	
MADRID	1	2		3		6	2	4		5		17	29			5			6	1		81	SWT-1
ANDALUCÍA	1	3		1		1		1	1	3				1	5				3	2		22	Portugal- 2
CANARIAS															1	1						2	
EUROPA								1				1										2	
Total ENVÍA	9	9	3	14	5	9	12	8	24	12	3	55	49	1	18	17	0	0	12		260	262	Envía a Europa
								ET-1				ET-1								4	Recibe de Europa		

TABLE 6: LIVER EXCHANGE WITHIN AUTONOMOUS COMMUNITIES IN 2013

3.4.1.5 Pancreas transplants

During 2013, 92 transplants of this kind were made in Spain. There are 13 health centres which are authorized to perform them, as the Table 7 shows together with the combined transplants with involve at least a pancreas. The Spanish index for pancreas transplant is 2,0pmp, similar to other European countries but below USA (3,3) or United Kingdom (4,0)

TRASPLANTES DE PÁNCREAS EN ESPAÑA (Páncreas -Riñón y otras combinaciones)							
CC.AA	Hospital	2008	2009	2010	2011	2012	2013
Andalucía	H. Reina Sofía	8	10	8	11	11	12
		(1PA)	(1PA)				(2PA)
	H. Regional de Málaga	15	13	14	12	7	6
		(1PA)	(1PA)	(3PA)	(3PA)	(1PA)	(4PA)
Canarias	H. Univ. de Canarias	9	9	8	8	5	3
		(1PA)		(1PA)	(2PA)		
Cantabria	H. M. Valdecilla	2	3	6	7	1	13
			(1PA)	(3PA)	(3PA)		(3PA)
Castilla y León	C.A. Salamanca		9	6	5	6	8
Cataluña	H. Clinic i Provincial	35	24	22	17	12	18
		(9PA)	(5PA)	(9PA)	(3PA)	(5PA)	(5PA)
	H. G.T.P. Badalona	2	1	1	6	3	1
Com.Valenciana	H. Gral. La Fe	10	5	8	11	6	9
					(1PA)	(1PA)	
Galicia	H. Universitario de A Coruña	5	6	4	10	5	4
		(1PA)	(1PA)		(1PA)	(2PA)	(1PA)
	C.H. Universitario. Santiago			1	1		
Madrid	H. Doce de Octubre	18	12	10	12	20	11
		(2PA) (1MV)	(1PA) (1MV)	(1PA) (1MV)	(1PA)	(11PA)	(3PA)
	H. La Paz Infantil	5	4	5	5	7	7
		(5MV)	(4MV)	(3MV) (1HRPa) (1HPa)	(5MV)	(6MV) (1HPa)	(7MV)
Murcia	H.V.de la Arrixaca	1	1	1	6		
	Total del Estado:	110	97	94	111	83	92

HRPa:Tx.Hígado-Riñón-Páncreas
HPa:Tx.Hígado-Páncreas
HCPa:Tx.Hígado-Corazón-Páncreas
PA:Tx Páncreas aislado
MV:Tx Multivisceral (Tx de más de 2 órganos abdominales siendo uno de ellos Intestino)

TABLE 7: PANCREAS TRANSPLANTS IN SPAIN, HOSPITALS THAT PERFORM PANCREAS TRANSPLANTS

3.4.1.6 Lung transplants

285 lung transplants were registered during 2013 in Spain, this year been the record since they started making them in 1990 (in 2012 they performed 238, for example), and also it has beaten the cardiac transplants. There are only 7 hospitals authorized to perform this kind of transplant within Spain, and they have achieved an index of 6,0pmp, higher than the USA one (5,6) or the 3,5 that the European Union had in 2012 (there are no data of 2013 yet).

Tabla 6.I. Nº de Trasplantes Pulmonares por centros desde el inicio de la actividad

Hospital	1990-2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Total Acumulado
H. Gregorio Marañón	5 (4)														5 (4)
H. Vall d´ Hebrón	171 (100)	29 (25)	36 (33)	23 (20)	31 (28)	34 (28)	27 (19)	43 (27)	51 (31)	51 (38)	61 (39)	49 (28)	66 (34)	69 (42)	741 (492)
H. Puerta de Hierro	143 (84)	27 (25)	27 (19)	25 (20)	31 (21)	40 (24)	46 (25)	35 (22)	31 (21)	34 (24)	35 (26)	32 (22)	30 (17)	37 (28)	573 (378)
H. La Fe	178 (142)	24 (17)	25 (24)	21 (19)	22 (20)	21 (18)	26 (15)	30 (24)	23 (17)	24 (16)	24 (16)	28 (20)	30 (22)	29 (17)	505 (387)
H. Reina Sofía	118 (81)	19 (6)	19 (14)	23 (17)	15 (8)	20 (15)	22 (13)	26 (11)	23 (9)	27 (13)	25 (18)	24 (14)	24 (11)	34 (14)	417 (244)
H. Marqués Valdecilla	50 (29)	12 (9)	22 (16)	21 (11)	20 (14)	23 (18)	25 (19)	16 (12)	23 (13)	33 (24)	30 (18)	44 (28)	34 (22)	49 (26)	402 (257)
H. Ramón y Cajal	22 (19)	8 (5)	10 (3)	6 (4)	2 (1)										48 (32)
H. Doce de Octubre									1 (1)	10 (5)	14 (6)	17 (9)	18 (15)	25 (17)	85 (53)
C.H.U. A Coruña	24 (21)	24 (18)	22 (14)	30 (9)	22 (10)	29 (9)	23 (11)	35 (12)	40 (10)	40 (6)	46 (7)	36 (9)	35 (9)	42 (17)	448 (162)
H. La Paz Infantil*													1 (1)		1 (1)
Total Anual	**709 (480)**	**143 (105)**	**161 (123)**	**149 (100)**	**143 (102)**	**167 (112)**	**169 (102)**	**185 (108)**	**192 (102)**	**219 (126)**	**235 (130)**	**230 (130)**	**238 (131)**	**285 (161)**	**3.225 (2.010)**
Trasplantes infantiles	**39**	**2**	**7**	**10**	**6**	**6**	**6**	**6**	**6**	**9**	**4**	**6**	**7**	**5**	**119**

*** Programa Interhospitalario H.U. Puerta de Hierro/H.U. La Paz Infantil;**
(Bp): Trasplantes Bipulmonares. Incluyen Tx.Cardiopulmonar; Tx infantiles comprende hasta los 15 años de edad (incluidos en el total)

TABLE 8: EVOLUTION OF LUNG TRANSPLANTS IN SPAIN

3.4.1.7 Kidney transplants

During 2013, Spanish hospitals performed 2.552 kidney transplants, which 67 were done in children (under 15 years old). Its index is 46,1, higher than many European or other countries. Nowadays, Spain possesses 46 hospitals that can perform this kind of transplants (39 for adults, 7 for children).

The tables 9 and 10 show the kidney exchange within Autonomous Communities and where the transplants were performed respectively.

Tabla 3.VIII INTERCAMBIO RENAL ENTRE COMUNIDADES AUTÓNOMAS. AÑO 2013 (Órganos Implantados)

	CC.AA DE GENERACIÓN																				
CC.AA IMPLANTE	GALICIA	ASTURIAS	CANTABRIA	PAÍS VASCO	NAVARRA	ARAGÓN	LA RIOJA	CATALUÑA	BALEARES	C.VALENCIANA	MURCIA	CASTILLA Y LEÓN	CASTILLA-LA MANCHA	EXTREMADURA	MADRID	ANDALUCÍA	Ciudad A.de Ceuta	Ciudad A.de Melilla	CANARIAS	EUROPA	Total RECIBE
GALICIA		2										7			1						10
ASTURIAS	1											2									3
CANTABRIA	1	7		9								1		1							19
PAÍS VASCO	1		4				10			1		4									20
NAVARRA	1		1			2	2					1									7
ARAGÓN							1					2									3
LA RIOJA				16																	16
CATALUÑA	5	2		3	1	5	1		12	15		3			9	1			2		59
BALEARES																					0
C.VALENCIANA									1				2		4	2					9
MURCIA															2						2
CASTILLA Y LEÓN															1						1
CASTILLA-LA MANCHA										2	1				1						4
EXTREMADURA		2										1									3
MADRID	3	2		6	2	2		1	1	5	7	42	12	4		4			3		94
ANDALUCÍA												1		1	2				1		5
CANARIAS																					0
Europa																					0
																					255
Total ENVÍA	12	15	5	34	3	9	14	1	14	23	8	64	14	6	20	7	0	0	6	255	
																				0	

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TABLE 9: KIDNEY EXCHANGE WITHIN SPANISH AUTONOMOUS COMMUNITIES IN 2013

Tabla 3.II RELACION DE TRASPLANTES RENALES EN ESPAÑA					
CC.AA	Hospital	2010	2011	2012	2013
Andalucía	H. Puerta del Mar. Cádiz	46	72	73	67
	H. Reina Sofía. Córdoba	35	67	63	54
	H. Regional. Málaga	115	115	144	106
	H. Virgen del Rocío Infantil. Sevilla	6	12	5	11
	H. Virgen del Rocío Adultos. Sevilla	78	80	99	84
	H. Virgen de las Nieves. Granada	50	80	73	90
Aragón	H. Miguel Servet. Zaragoza	65	74	68	85
Asturias	H. Central de Asturias. Oviedo	43	53	50	48
Baleares	H. Son Dureta. Palma de Mallorca	43	43	52	39
Canarias	H. Univ. Canarias. Tenerife	87	90	61	63
	H. Insular de Gran Canaria	17	26	30	38
Cantabria	H. Marqués de Valdecilla. Santander	42	48	36	61
Castilla -La Mancha	H. General. Albacete	38	29	21	47
	H. V.de la Salud . C.H. Toledo	16	30	34	47
Castilla y León	Complejo Asistencial de Salamanca	51	45	56	48
	H. Clínico. Valladolid	42	40	61	60
Cataluña	H. de Bellvitge. L'Hospitalet	96	129	116	120
	H. Vall d'Hebrón Infantil. Barcelona	10	10	9	14
	H. Vall d'Hebrón. Barcelona	55	95	104	85
	H. Clinic i Provincial. Barcelona	132	131	136	124
	H. del Mar. Barcelona	52	62	50	71
	H.Germans Trías i Pujol. Badalona	33	78	58	57
	Fundació Puigvert. Barcelona	78	71	78	62
	H. Sant Joan de Deu.Infantil	4	5	8	7
C. Valenciana	H. La Fe Infantil. Valencia	12	8	11	7
	H. La Fe Adultos. Valencia	82	71	101	90
	H. de Elche. Alicante			6	28
	H. General d'Alacant. Alicante	74	68	70	68
	H. Dr. Peset. Valencia	41	43	44	44
Extremadura	H. Infanta Cristina. Badajoz	32	44	34	30
Galicia	C.H. Universitario de A Coruña	104	117	119	108
	C.H. Universitario. Santiago	27	29	19	24
La Rioja	H. San Pedro. Logroño		10	5	16
Madrid	H. Doce de Octubre	152	149	154	141
	H. Ramón y Cajal	63	63	67	64
	H. Gregorio Marañón Infantil	1	6	1	2
	H. Gregorio Marañón Adultos	41	32	33	36
	H. La Paz Infantil	16	8	16	17
	H. La Paz Adultos	50	46	46	43
	H. Clínico San Carlos	73	76	65	57
	H. Puerta de Hierro	16	12	30	26
	Fundación Jiménez Díaz	8	14	20	20
Murcia	H. Virgen de la Arrixaca	47	54	76	61
Navarra	Clínica Univ. de Navarra. Pamplona	25	40	32	26
País Vasco	H. de Cruces Infantil. Baracaldo.	7	10	6	9
	H. de Cruces Adultos. Barcaldo.	120	113	111	147
	TOTAL DEL ESTADO	2225	2498	2551	2552
	Trasplantes de donante vivo	240	312	361	382
	Trasplantes Infantiles	58	63	59	67

TABLE 10: EVOLUTION OF KIDNEY TRANSPLANTS FROM 2010 TO 2013 IN THE DIFFERENT AUTONOMOUS COMMUNITIES AND HOSPITAL WHERE THEY WERE PERFORMED

3.4.1.8 Data analysis conclusion

In order to take a decision on which Spanish cities are the ones that need a base to contribute to time-efficient performances on transplant transportations, the following tables put together the information from sections 3.4.1.1 to 3.4.1.7:

	ANDALUCÍA (Sevilla)		ARAGÓN (Zaragoza)		ASTURIAS (Oviedo)		BALEARES (Palma de Mallorca)		CANARIAS (Santa Cruz de Tenerife / Las Palmas)	
	< 20km	> 20km	< 20km	> 20km	< 20km	> 20km	< 20km	> 20km	< 20km	> 20km
CARDIAC TRANSPLANTS	X	X (Córdoba)	X		X					
BOWEL TRANSPLANTS	X	X (Málaga)	X							
LIVER TRANSPLANTS	X	X (Córdoba, Málaga, Granada)	X		X				X	
PANCREAS TRANSPLANTS		X (Córdoba, Granada)								
LUNG TRANSPLANTS	X									
KIDNEY TRANSPLANTS	X	X (Córdoba, Málaga, Cádiz)	X		X		X		X	

	CANTABRIA (Santander)		CASTILLA - LA MANCHA (Albacete / Toledo)		CASTILLA Y LEÓN (Valladolid / Burgos / León)		CATALUÑA (Barcelona)		COMUNIDAD VALENCIANA (Valencia)	
	< 20km	> 20km	< 20km	> 20km	< 20km	> 20km	< 20km	> 20km	< 20km	> 20km
CARDIAC TRANSPLANTS	X				X (Valladolid)		X		X	
BOWEL TRANSPLANTS	X						X			X (Alicante)
LIVER TRANSPLANTS	X				X		X		X	X (Alicante)
PANCREAS TRANSPLANTS	X					X (Salamanca)	X		X	
LUNG TRANSPLANTS	X						X		X	
KIDNEY TRANSPLANTS	X		X (A / T)		X (V)	X (Salamanca)	X		X	X (Alicante)

	EXTREMADURA (Mérida)		GALÍCIA (A Coruña / Santiago de Compostela)		LA RIOJA (Logroño)		COMUNIDAD DE MADRID (Madrid)		REGIÓN DE MURCIA (Murcia)	
	< 20km	> 20km	< 20km	> 20km	< 20km	> 20km	< 20km	> 20km	< 20km	> 20km
CARDIAC TRANSPLANTS			X (A Coruña)				X		X	
BOWEL TRANSPLANTS		X (Badajoz)	X (A.C / S)				X		X	
LIVER TRANSPLANTS		X (Badajoz)	X (A.C / S)				X		X	
PANCREAS TRANSPLANTS			X (A.C / S)				X		X	
LUNG TRANSPLANTS							X			
KIDNEY TRANSPLANTS		X (Badajoz)	X (A.C / S)		X		X		X	

	NAVARRA (Pamplona)		PAÍS VASO (Vitoria)	
	< 20km	> 20km	< 20km	> 20km
CARDIAC TRANSPLANTS	X			
BOWEL TRANSPLANTS				X (Bilbao)
LIVER TRANSPLANTS	X			X (Bilbao)
PANCREAS TRANSPLANTS				
LUNG TRANSPLANTS				
KIDNEY TRANSPLANTS	X			X (Bilbao)

TABLE 11: MAIN CITIES OF EACH SPANISH AUTONOMOUS COMMUNITIES WHICH HOST TRANSPLANT OPERATIONS

Therefore, the cities that would be suggested to find a suitable airport to host a base based on the location of the main hospitals that do transplants are (17): Sevilla (as a hub for Sevilla, Córdoba, Málaga, Granada and Cadiz), Zaragoza, Oviedo, Palma de Mallorca, Santa Cruz de Tenerife, Albacete, Valladolid, Salamanca, Barcelona, Valencia, Badajoz, A Coruña or Santiago de Compostela, Logroño, Madrid, Murcia, Pamplona and Bilbao.

3.4.2 Step 2: Transplant exchange movements within Spainsh regions

In order to determine the dimension of the bases and the number of airplanes that will be needed, a summary table of the transplant exchange movements between Spanish Autonomous Communities is required. Moreover, this will help to execute Step 3, to see which airports can support those specific requirements.

Below, the table reflects all the data collected from cardiac, kidney and liver transplants, as no other information from the other kind of transplants is available. The numbers reflect 'operations', which defined as a transported organ from an origin to a destination.

Origin \ Destination	ANDALUCÍA	ARAGÓN	ASTURIAS	BALEARES	CANARIAS	CANTABRIA	CASTILLA - LA MANCHA	CASTILLA Y LEÓN	CATALUÑA	COMUNIDAD VALENCIANA	EXTREMADURA	GALÍCIA	LA RIOJA	COMUNIDAD DE MADRID	MURCIA	NAVARRA	PAÍS VASCO	total organs sent (anual)	organs sent per day
ANDALUCÍA			2		1			2	4	4	1	4		17	5	1		41	0,1
ARAGÓN	1					2			5		1	1		10		2		22	0,1
ASTURIAS	4	2				12		1	2		2	2		5		2	1	33	0,1
BALEARES	1							1	37	2		1		3	1			46	0,1
CANARIAS	5							1	2	1		1		10				20	0,1
CANTABRIA			1									3				1	4	9	0,0
CASTILLA - LA MANCHA		2				1		1	3	5	7	1		44	6			70	0,2
CASTILLA Y LEÓN	5	4	7			5			11	2	2	13		65		10	11	135	0,4
CATALUÑA	1		1			2				4		2		13		1		24	0,1
COMUNIDAD VALENCIANA	3		1				2	1	23			3		16	1	1	1	52	0,1
EXTREMADURA	4					1						1		5				11	0,0
GALÍCIA	2	1	2			4			7	3				5	1	3	1	29	0,1
LA RIOJA		1	1			4			1			1		2		6	10	26	0,1
COMUNIDAD DE MADRID	11	1	2		1	3	1	2	17	4		3			3	1		49	0,1
MURCIA							1	1	3	1				7				13	0,0
NAVARRA									3	1				4			2	10	0,0
PAÍS VASCO	2	3	3			19		1	10	1	5	3	16	13				76	0,2
																		666	1,8

TABLE 12: NATIONAL TRANSPLANT EXCHANGE RATES IN SPAIN IN 2013

The results show that the current annual operations are smaller than the data that RFDS works with (in Dubbo they have 2,5 daily operations and in Alice Springs around 6 per day). This exposes a problem, whether it is feasible and convenient to implement RFDS model if less than an operation is done per day. If it is kept in mind all the resources that are needed per base (a plane, human resources like pilots, nurses and administration officers, etc.) and, therefore, the high cost of it, the conclusion is no, it is not worth it.

For this reason, although this project concludes that tracing the RFDS model (based in placing many small bases) does not work in Spain. The study will continue working in the implementation, working on the assumption that 3 to 5 bases are needed in order to help the organ flow. The bases will be chosen according to places where can cover the maximum Spanish surface possible.

3.4.3 Step 3: Selection of the most suitable airports

In order to decide exactly how many bases are needed to cover the entire Spanish surface, a map will be used:

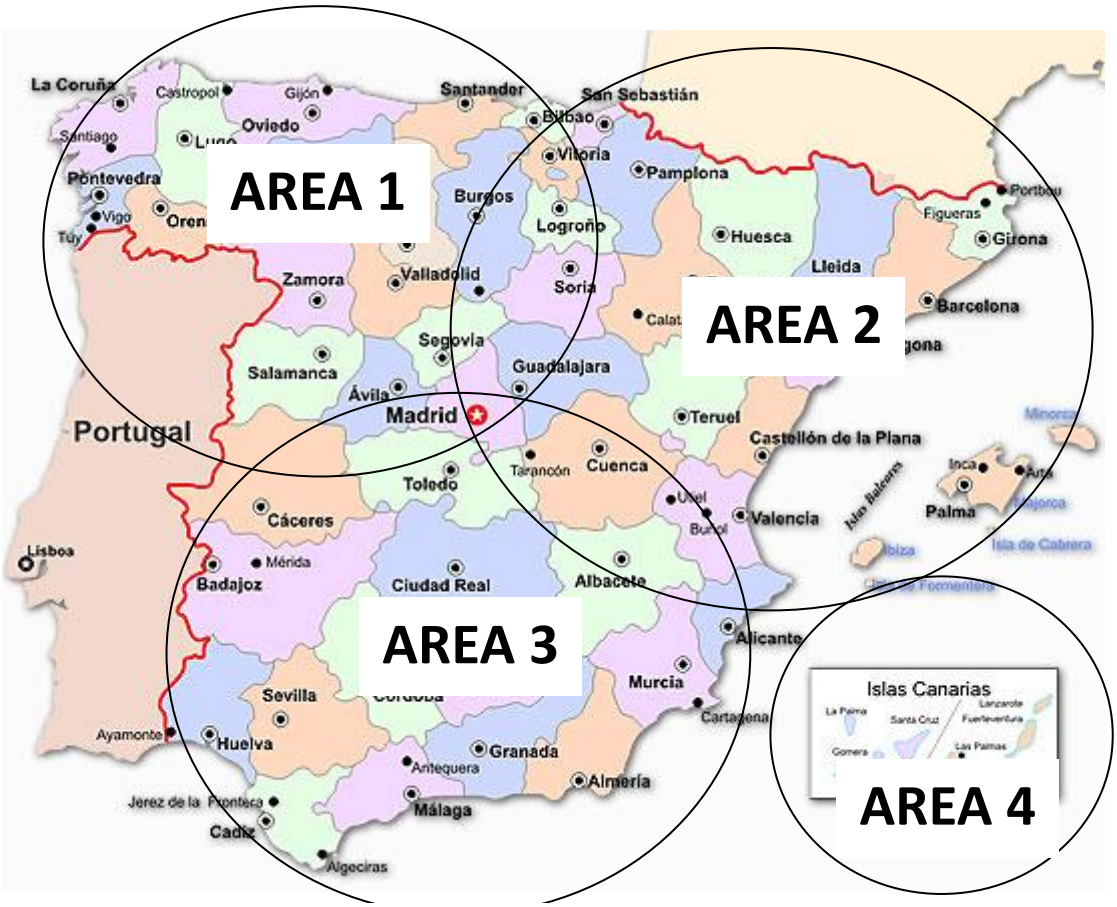

FIGURE 20: MAIN SPANISH AREAS WHERE A BASE IS SUGGESTED TO BE LOCATED

With the previous requirement of setting 3 to 5 bases within Spain, a suggested lay out is proposed. All the areas are around 600km from an extreme to the other. In order to decide four locations to place the bases, it will be taken in mind the top origin regions where organs are sent from and the cities within this areas where top transplant hospitals.

The available airports that could be suitable to place a base are:

- CASTILLA Y LEÓN: Valladolid and Salamanca are the main cities that do transplant operations. Both cities have airports too, so the schedule is a determining factor that will help taking a decision. Although Valladolid airport is the one that is open more hours (from 8.30am to 9.15pm), Salamanca airport (from 11am to 5.30pm) offers the possibility to extend the schedule exceptionally, as military aircrafts use the airport 24h a day. Therefore, **Salamanca airport** is the most suitable airport to cover Area 1.
- CASTILLA-LA-MANCHA: Albacete is the main city that does transplant operations, and as it has an airport, **Albacete airport**, this one is the most suitable airport to cover Area 3.
- PAIS VASCO: In Bilbao is where all the hospitals that do transplants are. As there is only one airport nearby this city, this one will be the most suitable to cover Area 2, **Bilbao airport**.
- CANARIAS: The main two cities, Santa Cruz de Tenerife and Las Palmas, have airports. The same criteria used for the Area 1 will be used to decide which airport could be used to be base for Area 4: Tenerife have restricted schedules and Las Palmas airport operates during 24h, so **Gran Canaria Airport** will be the chosen one to be a base for Area 4.

3.4.4 Step 4: Selection of the type of aircraft

A table with the different aircrafts that the *Royal Flying Doctor Sevice of Australia* could adapt and transform them into flying medical units are the following ones.

NAME	SPEED (cruising)	RANGE	COST* (aprox.) *2009 delivers
Cessna C208	340 km per hour	1.797 km	US$ 1.950.000 (airplane) + US$ 2.000.000 (fittings as a flying intensive care unit)
King Air 200	480 km per hour	3.500 km	US$ 3.300.000 (airplane) + + US$ 2.000.000 (fittings as a flying intensive care unit)
Pilatus PC-12	519 km per hour	2.915 km	US$ 3.550.000 (airplane) + US$ 2.000.000 (fittings as a flying intensive care unit)

TABLE 13: MAIN CHARACTERISTICS OF RFDS CURRENT AIRCRAFTS

By the recommendation of the experts in aviation in Sydney Mascot base, the Cessna C208 would be rejected, as in their opinion it is an old-fashion aircraft that is quite expensive to

maintain, and also the training facilities are only located in US, and as the training is a must do every year for pilots, the indirect costs would be very high.

In contrast, the King Air 200 is the version of airplane that the RFDS use more and, therefore, recommend to use it as it is very reliable and common aircraft.

3.4.5 Step 5: Make a budget for the implementation

Following the expenses classification given in the annual reports of RFDS, the following budget would be needed in order to start the operations in Spain: a total of almost 19.5 million Euros as an initial investment, and the annual operations would cost around 3.7 million Euros.

NAME OF THE SECTION	BUDGET
Administration	289,100.00€
Aviation costs	2,426,112.74€
Employment costs	729,560.96€
Facilities costs	245,520.00€
TOTAL	**3.690.293,70€**

TABLE 14: EXPECTED ANNUAL EXPENSES IN SPAIN OPERATIONS

NAME OF THE SECTION	BUDGET
Aircrafts (2,961,222€ per aircraft) 4x	11,844,888.00€
Adaptation to a flying intensive care unit (1,794,680€ per aircraft aprox.) 4x.	7,178,720.00€
Information Technologies (IT) systems (100,000€ central, 4x 50,000€)	300,000.00€
Furniture and other equipment (4x 25,000€)	100,000.00€
TOTAL	**19,423,608.00€**

TABLE 15: EXPECTED INITIAL INVESTMENTS

3.4.5.1 Administration

CONCEPT	ANNUAL COST
IT maintenance and software (22% of 300,000€)	66,000.00€
Communications	100,000.00€
Stationery	2,300.00€
Administration salaries (4 people)	112.000,00€
Land line cell phone and mail	4.800,00€
Others	4.000,00€
TOTAL	**289.100,00€**

TABLE 16: ADMINISTRATION ANNUAL COSTS

3.4.5.2 Aviation costs

CONCEPT	ANNUAL COST
Landing and transit services in airports: average of 4.685594€/Tm, Weight-Max Take-off 5,669.9kg (Aena 2015 rates) **666 organs transported in 2013**	4.685594€/Tm * 5.6699Tm * (666*2)operations = 35,387.04€
King Air B200 costs* - **Variable Costs per hour (1,098.70€/h)** - **Annual Fixed Costs (60,199€; HR resources excluded)** **666 organs transported in 2013, aprox. 1.5h/flight**	(1,098.70€ * (666 x (1.5h x 2)) hours + 60,199€ = 2,195,202.6 + 60,199 = 2,255,401.60€
Market Depreciation (6% of aircraft	135,324.10€

costs/year)*	
TOTAL	**2,426,112.74€**

TABLE 17: AVIATION ANNUAL COSTS

* Estimated annual costs calculated through the program "Aircraft Cost Evaluator". Summary of the King Air B200 costs are found in Appendix 2.

3.4.5.3 Employment costs

CONCEPT	COST
Wages and salaries : 2 pilots and 2 mechanical engineers per base	36,583.76€ + 289,928.00€ = 659,511.76€
Other associated personnel expenses: annual training (1,751.23€/h)	70,049.20€
Contributions to defined contribution superannuation funds	*NOT included
Increase in provision for employee leave entitlements	*NOT included
TOTAL	**729,560.96€**

TABLE 18: EMPLOYMENT ANNUAL COSTS

3.4.5.4 Facilities costs

CONCEPT	ANNUAL COST
Rental (Aena 2015 rates) - **Gran Canaria: 11.56€/month/m2** - **Bilbao: 9.10€/month/m2** - **Albacete: 3.87€/month/m2** - **Salamanca: 3.87€/month/m2**	(11.56*12*650) + (9.10*12*650) + (3.87*12*650) + (3.87*12*650) = 221,520.00€
Utilities (4 bases)	24,000.00€
TOTAL	**245,520.00€**

CHAPTER IV – Conclusion

4.1 Summary results

The main results of this project are four. First of all, it has been studied with much detail the operations, resources and infrastructures of the *Royal Flying Doctor Service*. Thanks to the fieldwork that was done during five months, the outcomes achieved are very satisfactory as apart from the general impression, all the departments of RFDS were studied.

Moreover, the operational model of the organization has been successfully extrapolated to the Spanish case of the organ health transportation. The research conducted in both the Australian and Spanish scenarios has provided enough information and data to implement satisfactorily the overall operational model of RFDS in Spain.

Thirdly, the analysis of the data provided from the annual reports of the ONT showed that for the current number of organ operations within Spain, only 4 bases are needed in order to offer the air transportation service within the different Autonomous Communities.

And to finalize, the research and work of this project concluded with the fact that if this model is wanted to be implemented, 19.5 million Euros and 3.7 million Euros would be needed as initial investments and annual expenses respectively if four bases within the Spanish territory were settled.

4.2 Balance of objectives

After the realization of the project, the balance of objectives established at the beginning of the work is positive. Following a procedure while researching has helped the application of the knowledge acquired in the section of implementation.

- ✓ **GOAL 1**: Familiarize with the Australian Aviation industry. ACHIEVED

  Thanks to the fieldwork done with the organization *Royal Flying Doctor Service*, knowledge has been gained regarding of the Australian Aviation Industry. For example, requirements and aviation regulatory authorities, such as CASA, have emerged in consequence of investigating how RFDS works.

- ✓ **GOAL 1.1**: Become aware of the medical aviation statuses within the Australian regulation.

Through interviews with staff (especially discussions with Andrew Duma) from the RFDS Sydney Mascot base, this project has examined the different statuses that are established in Australia. Basically with the (1) medi-evacuation status, the ATC can move every other aircraft aside to let the RFDS aircraft first and also can get direct tracking to wherever they need to go. The (2) hospital status has more priority than normal commercial flights but less than a medi-evacuation status.

- ✓ **GOAL 1.2**: Become aware of the airstrip requirements within the Australian regulation.

CASA, the *Civil Aviation Safety Authority*, published the CAAP 92-1, the Airstrip standards & Reporting Arrangements documents, which were accessed for the realization of this project.

- ✓ **GOAL 2**: Deepen the knowledge of the organization *Royal Flying Doctor Service of Australia* in order to form a clear idea of their operational model. ACHIEVED

During the duration of this project, direct access to the institution had been a major success, as a five month fieldwork was conducted, which helped gain knowledge of their operational model.

- ✓ **GOAL 2.1**: Establish contact with professionals working in RFDS.
- ✓ **GOAL 2.2**: Have access to primary sources of information of the organization, such as diaries, interviews and observations.

(For G.2.1 and G2.2) Different interviews, discussions, meetings and simple observations in different sections of the organization (Administration, Engineering, Medical services, Management, etc.) took part during the fieldwork.

- ✓ **GOAL 2.3**: Have access to secondary sources of information of the organization, such as operational manuals, newsletters and history textbooks.

During the fieldwork, Operational Manuals were used to have access to the operational procedures that RFDS currently uses, although any photos or

photocopies couldn't be done. Moreover, access to internal employee newsletters was also allowed, and in one of them the author of this project took part of it.

- ✓ **GOAL 2.4**: Visit the ground facilities of RFDS.

  Thanks to the RFDS organization, a fieldwork mainly in the Sydney ground facilities but also in Dubbo was conducted.

- ✓ **GOAL 3**: Study the compatibility of the current Spanish aviation system with the RFDS operational model. ACHIEVED

The compatibility between Spain and Australia was positive. The research and work of this project concluded with the fact that if this model is wanted to be implemented, 19.5 million Euros and 3.7 million Euros would be needed as initial investments and annual expenses respectively if four bases within the Spanish territory were settled.

Although it might be good results, I would like to point out that implementing the infrastructure in only four bases was not the expected and, therefore, the compatibility was not 100% wide-ranging. The transplant movements between Spanish Autonomous Communities were very disappointing and affected the planning of the finalizing phase of the project. As there was not even an operation per day in every Autonomous Community (in RFDS bases they do at least 4 daily), putting a base in every one of those was not feasible and realistic, as they were not needed. Therefore, a decision of concluding by determining the no possibility of implementing the model in Spain was disappointing and insufficient. For that reason, a hypothetic scenario of much bigger areas (which included several Autonomous Communities) resolved the problem and gave the opportunity to continue with the plan of implementation.

4.3 Future work

During the realization of this project, doubts, alternatives and different scenarios within this topic have emerged. Although I couldn't dedicate specific sections for them due to the length of the project, I think dedicate future investigations on the following topics would be interesting:

- Exploration of the ONT operational needs regarding the organ transportation, as it is possible that if this transportation service was available, many more transplantations would be feasible due to the quickness of the transport.
- Adaptation of the RFDS model into Spain (not just tracing the model).
- Detail of the operational model that the new Spanish organization would have.
- Ways of funding the new organization (where the money could come from).

4.4 Personal thoughts

I am very satisfied with the outcome of this project and its realization during all these last 5 months. First of all, *Royal Flying Doctor Service* (especially Mark Prior, manager of a the Sydney Mascot base) has given me a huge opportunity by letting me spend a day once a week in their bases researching their operational model, observing real operations and meetings between employees. But not only that, I participated in real training courses that the workers need to do and I am very thankful for that. Therefore, I have gained experience in the Australian Aviation Industry and enriched my aeronautic and business knowledge.

Also, although the implementation of the procedures and knowledge from the RFDS back in the Spanish industry has been more complicated basically because of the physical distance, thankfully I didn't have any problems, as I found a lot of information that assisted me completing that part.

To finalize, I would like to comment that I think that fieldwork is the best way to keep connected with the industry and get real outcomes as well as a source of motivation that helped me enjoy every single second of the whole duration of doing this project; I would definitely recommend and encourage students to do end-of-degree projects with the collaboration of a specific organization.

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