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Faro Aerotropolis: Applying the Concept to a Medium-sized City

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Dedicatory

To my parents for all their efforts, patience, support and affection.

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Abstract

Air traffic has been on a constant rise throughout the years, making it necessary to create a response to this increasing demand. One way to keep up with this growth is by implementing an Aerotropolis solution.

Aerotropolis is a term that first came in 1939 by the hand of Nicholas DeSantis, with an illustration of a 200-stories high skyscraper capped by an airplane field eight city blocks long and three blocks wide. However, in 2000, Dr John Kasarda redefined this term into a new concept, which is the purpose of this work. The new concept meets the continuous growth of air travelling by making the city serve the airport, instead of the opposite traditional way.

The key value of the Aerotropolis is that it offers businesses rapid connectivity on a massive scale. Keeping this in mind, the main goal of this work is to try to apply and develop an Aerotropolis at Faro International Airport. It is possible to establish the evolution of the businesses, using a GIS approach, related to the airport in the Catchment Area throughout the years, and from there determine whether an Aerotropolis in this region is conceivable. This evaluation of the Catchment Area requires data gathering from various sources, like CENSUS and INE. This data provides a useful tool to assess the possibility to adapt this airport into an Aerotropolis. Other operational Aerotropolis examples such as Amsterdam and Paris will serve as a comparison, granting a realistic scenario, more so than the general Aerotropolis schematic.

The case study is Faro International Airport, which serves the Algarve region. This airport has a 60-minute travel time suggested by airport authorities for its Catchment Area. This work has its main objective to determine the possibility of an Aerotropolis in the region and its impact as a better option for the overall efficiency of the airport.

Keywords

Faro Airport, Aerotropolis, GIS, Airport City, Catchment Area

Resumo

O tráfego aéreo tem exibido uma constante subida ao longo dos anos, sendo necessário criar uma estratégia para responder a esta procura. Uma das maneiras de acompanhar este crescimento é com a implementação do modelo Aerotropolis, isto é, usar este modelo e aplicar a aeroportos que já existam, ou outros que estejam a ser planeados e projectados.

O termo Aerotropolis apareceu pela primeira vez em 1939 pela mão de *Nicholas DeSantis*, com uma ilustração de um arranha-céus de 200 andares de altura, coberto por uma pista de aterragem com um comprimento de oito quarteirões e três de largura. No entanto, em 2000 o *Dr. John Kasarda* redefiniu este termo num novo conceito, que é o propósito deste trabalho. Este novo conceito vai de encontro ao crescimento contínuo da indústria da aviação, alterando o paradigma, sendo assim a cidade que serve o aeroporto.

O maior valor do *Aerotropolis* é que oferece rápida conectividade comercial em grande escala. Com isto em mente, o principal objetivo desta dissertação é tentar aplicar e desenvolver um Aerotropolis no Aeroporto Internacional de Faro. Usando uma abordagem de Sistemas de Informação Geográfica (SIG) é possível ligar a evolução dos negócios relacionados com o aeroporto na sua área de influência ao longo dos anos, e a partir dai determinar se um *Aerotropolis* é possível na região. Esta avaliação da Área de Influência requer uma recolha e selecção de dados de várias fontes tais como CENSUS e Instituto Nacional de Estatística (INE).

Estes dados são uma ferramenta para avaliar a possibilidade de adaptar este aeroporto a um *Aerotropolis*. Outros exemplos de Aerotropolis operacionais, aeroportos que decidiram usar este modelo, como Amesterdão e Paris *Charles de Gaulle*, servirão de comparação garantindo um cenário mais realístico do que o esquema geral do *Aerotropolis*.

O caso de estudo será o Aeroporto de Faro, que serve a região do Algarve. Este aeroporto tem uma área de influência de 60 minutos de viagem sugerida pelas autoridades aeroportuárias. Este trabalho tem como objetivo determinar a possibilidade de um *Aerotropolis* na região e o seu impacto como uma melhor opção na eficiência geral do aeroporto.

Palavras Chave

Aeroporto de Faro, Aerotropolis, SIG, Airport City, Área de Influência

Resumo Alargado

Introdução

O resumo alargado que se segue destina-se a resumir em língua portuguesa, o trabalho de investigação que permitiu elaborar esta dissertação. É composto por uma delineação do enquadramento da dissertação, de seguida são apresentados os objectos e objectivos que a compõem e finda com aquelas que serão as minhas principais conclusões e com a indicação das perspectivas de investigação futura sobre o tema.

Enquadramento da Dissertação

Desde o ano de 1980 que se regista um aumento no tráfego aéreo. Um estudo da *Eurocontrol* veio confirmar essa ideia, apresentado um aumento nos movimentos aéreos e também nos movimentos relativos às aeronaves e aos passageiros [1]. É estimado que, seguindo aquele que tem sido o progresso deste campo, os valores apresentados continuem a prosperar.

Consequentemente torna-se essencial investigar e desenvolver uma resposta para a crescente necessidade que visa melhorar a eficiência do tráfego aéreo. É vital agilizar a circulação de quem usa os aeroportos, mas sem com isso esquecer aqueles que fazem uso dos meios e infraestruturas que estão dentro da área de influência do aeroporto.

O *Aerotropolis* pode ser a solução. Este conceito, desenvolvido pelo Dr. *John Kasada*, caracteriza-se como um modelo dinâmico que dá resposta ao crescimento e evolução no âmbito de operação e gestão de aeroportos.

Em tempos transactos, o aeroporto servia a cidade. Atualmente, e tendo em conta que o panorama futuro pode não ser semelhante ao que observamos agora, a evolução do transporte aéreo vem mudar essa realidade, que até então era dada como certa. Como é possível observar em Amesterdão (*Schiphol*) e em Paris (*Charles-de-Gaulle*), por exemplo, o *Aerotropolis* promove a ideia de criar as cidades à volta do aeroporto, de forma a facilitar as actividades relacionadas com o transporte aéreo comercial e de passageiros [2].

O *Aerotropolis* é caracterizado pela avaliação dos indicadores socioeconómicos dentro da sua área de influência, área essa que já foi pré-estabelecida num trabalho anterior [3] a este. Neste trabalho debruçamo-nos sobre o Aeroporto Internacional de Faro. O caso de estudo do dito projecto consiste em procurar adaptar a zona de Faro a um *Aerotropolis*, de forma a perceber se é possível implementá-lo na área. Uma correcta implementação é essencial para o desenvolvimento com sucesso do *Aerotropolis*.

Objectos e Objectivos

Com o objectivo de escoar de forma competente as pessoas e bens do aeroporto de Faro e da sua área de influência, procura-se nesta dissertação averiguar uma possível adaptação da zona a um *Aerotropolis*, tornando assim, o Aeroporto Internacional de Faro no objecto da dissertação.

Com este objecto surgem três objectivos, cuja finalidade é estipular metas que se vão mover em torno do já referido objecto. Isto significa que os três objectivos que vamos apresentar simbolizam os passos que marcam o caminho da investigação.

O primeiro objectivo consiste em identificar os vários tipos de negócios que, graças à presença do aeroporto na zona, se podem encontrar na área de influência do aeroporto de Faro. O método de análise que torna possível esta apreciação é através da avaliação dos indicadores socioeconómicos dos concelhos delimitados pela área de influência do aeroporto, durante um determinado período de tempo.

Em seguida, é apresentado o segundo objectivo. Vamos traçar e investigar o crescimento dos ditos negócios ao longo dos anos. Para tal, foi utilizado o *software ArcGis*, criando mapas que ilustram a disparidade ou evolução dos vários indicadores socioeconómicos. Foram utilizados dados de entidades (como o Instituto Nacional de Estatísticas ou o Pordata) sobre quando e onde é que os negócios foram criados ou transferidos para a área de influência do Aeroporto Internacional de Faro.

Por fim, o terceiro e último objectivo passa pela compilação da informação previamente recolhida e determinação se é ou não exequível adaptar o aeroporto de Faro a um *Aerotropolis*. Tal só é possível recorrendo à comparação com exemplos de outras cidades e aeroportos adaptados a *Aerotropolis*.

Principais Conclusões

Fornecendo cerca de 56 milhões de postos de trabalho e com um impacto na economia de mais de 2 triliões de dólares, a indústria aérea representa, atualmente, um dos principais "motores" da economia à escala global [4]. Só em Portugal, o setor da aviação representa 5.7 biliões de euros do Produto Interno Bruto (PIB) e cerca de 184 mil empregos [5].

Tal como os portos marítimos no século XVIII, os caminhos-de-ferro do século XIX ou as autoestradas no século XX, os aeroportos vêm criar uma nova economia geográfica ao definirem a localização dos negócios e o desenvolvimento da industria [3:pp 2].

No já supracitado estudo da Eurocontrol, é estimado que no ano de 2035 existam o dobro dos voos que existem no presente ano e que esse valor em 2050 seja ainda maior. Ora, com o aumento do tráfego aéreo torna-se necessário que os aeroportos e as suas áreas de influência sejam capazes de responder à crescente procura e maior movimentação de pessoas e bens. Isto significa que é essencial tornar a circulação daqueles que fazem uso dos aeroportos, mas também de quem usufrui dos meios ou serviços que se encontram na sua área de influência.

Assim surge o conceito do Aerotropolis. Este modelo dinâmico vem apresentar uma tão necessária resposta ao crescimento e evolução no âmbito de operação e gestão de aeroportos. Desta forma, já não é o aeroporto a servir a cidade, mas a cidade é que se desenvolve e expande a partir dele. O Aerotropolis promove uma maior eficácia aquando do escoamento de bens e pessoas, facilitando as actividades que estão relacionadas com a indústria da aviação.

Esmiuçando agora aquele que é a epígrafe da dissertação, há que considerar o Aeroporto Internacional de Faro como o objecto da dissertação. Explorou-se a possibilidade e viabilidade de moldar o aeroporto de Faro e a sua área de influência a um Aerotropolis para melhor satisfazer os interesses daqueles que fazem uso do aeroporto ou de infraestruturas da sua área de influência. Conjuntamente analisamos dados respeitantes a um intervalo de vários anos, com o propósito de determinar como é que a presença do aeroporto afectou os negócios da região que delimita.

O Aerotropolis é uma evolução para um modo de vida e operação mais eficientes, uma vez que bens e indivíduos que se movem junto ou até mesmo no aeroporto estejam mais facilmente conectados. A fase fulcral para o sucesso da implementação do Aerotropolis é o seu planeamento.

A partir da área de influência previamente estabelecida, foi possível identificar os concelhos que se encontram dentro dessa área. A avaliação dos indicadores socioeconómicos dos concelhos em 3 períodos distintos (2001, 2011 e 2016) permitiu a elaboração de mapas, cuja finalidade é a delineação da evolução nesses períodos. Após esta avaliação, foi possível traçar um plano que sugere mudanças que possibilitam a adaptação do Aeroporto Internacional de Faro a um modelo de Aerotropolis (Figura 1).

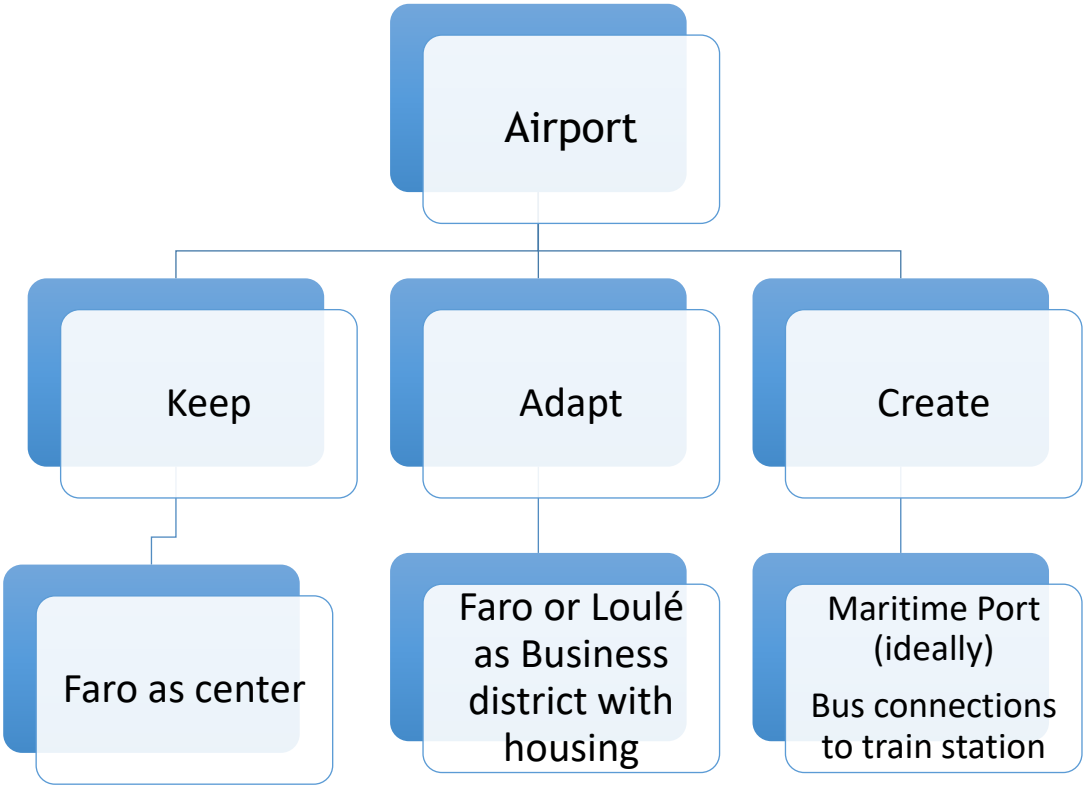

Figure 1 – Faro Aerotropolis Schematic.
Source: Own elaboration.

Perspectivas de Investigações Futuras

O setor da aviação é o responsável pela criação de um novo modelo de economia de negócios, visto que os aeroportos estão a criar uma nova era no desenvolvimento, quer urbano, quer industrial. Para que os aeroportos atinjam bons resultados em *rankings* (e uma vez que a eficiência é fundamental) as regiões que se encontram ao seu redor devem-lhes acrescentar valor e criar impacto umas nas outras.

Após a já relatada importância do Aerotropolis na conquista de uma eficiência que solucione as questões levadas com os cada vez maiores movimentos relacionados com o tráfego aéreo, uma futura investigação e desenvolvimentos neste campo devem posicionar-se em 6 momentos.

Numa fase primária, é imprescindível averiguar um novo modelo que arquive toda a informação sobre o desempenho do aeroporto com a área de influência do mesmo. De seguida, devem ser apurados os melhores indicadores para descrever e caracterizar a região envolvente ao aeroporto. O terceiro ponto consiste em inserir todas as informações geográficas da área de influência do Aeroporto Internacional de Faro no software GIS. Seguidamente, a rede de transportes é alargada a outras formas de transporte, como comboios ou transportes de bens e pessoas através da água, aproveitando a proximidade ao mar. Quantos mais tipos de transportes funcionarem em consonância com a cidade e o

aeroporto, maior é a eficiência alcançada. O quinto momento diz respeito aos aeroportos de Lisboa e do Porto. Dado que são das maiores cidades do território português e ambas têm uma grande importância para o nosso país, sendo Lisboa a nossa capital, há que considerar a exequibilidade e possibilidade de um Aerotropolis nas duas. Por fim, elaborar um estudo sobre a possível limitação do aeroporto de Beja a um uso comercial, aliviando os aeroportos de Lisboa e de Faro nos seus excessos de limite de movimentos.

Referências

[1] EUROCONTROL, "Challenges of Growth 2013 Task 7: European Air Traffic in 2050 Network Manager nominated by the European Commision," 2013.

[2] York Aviation, "The social and economic impact of Airports in Europe," *Airports Counc. Int.*, no. January, pp. 353-354, 2004

[3] P. Alves, "Determination and Evaluation of an Airport Catchment Area: a Portuguese Case Study", Universidade da Beira Interior, 2014.

[4] Rolls-Royce and Safran, "Powering Global Economic Growth, Employment, Trade Links, Tourism and Support for Sustainable Development Through Air Transport," *Int. Air Transp. Assoc.*, vol. 16, p. 80, 2016.

[5] M. Dierikx, "Essay: Love from above Essay: Fostering growth in emerging markets Essay: Global travel for all Looking at the role aviation has played in developing social and cultural ties," no. April, 2014.

Table of Contents

List of Figures

List of Tables

List of Acronyms

ANSR	National Authority of Road Safety
ANA	Airports of Portugal
CDG	Charles de Gaulle
FAO	Faro
GDP	Gross Domestic Product
GIS or SIG	Geographical Information System
INE	National Statistics Institute
LCC	Low-Cost Carriers
NUTS	Nomenclature of Territorial Units for Statistics
REITs	Real Estate Investment Trusts
US	United States

Chapter 1 - Introduction

1.1 Motivation

Air transport has grown in recent decades at a fast pace, and the forecast according to an EUROCONTROL study [1] is to continue to grow.

Figure 1.1- Prediction of the number of aircraft movements until 2050.
Source: [1].

In Figure 1.1, we can see that according to the most likely scenario, in 2035 there will be approximately 50% of flights that currently exist, and the forecast for 2050 indicates that this number will double in the face of current.

The impact of air transport activity over the global economy is massive as it supports 56.6 million jobs and over $2.2 trillion in the global economic impact of aviation worldwide [2]. In Europe, the aviation sector generates 8.7 million jobs and $749 billion in GDP (Gross Domestic Product); also, 605 million passengers have flight through 701 commercial airports available [3]. From Portugal standpoint, air transport represents nearly €5.7 billion in GDP and 183 thousand jobs [4].

Airports have become necessary infrastructure for a wide range of economic activities nowadays, allowing people and goods to move on a global scale. Airports are essential to the modern global economy, as they represent high-speed access for freight, business and leisure travellers, but also contribute to social development and for better life quality. A major role

can be attributed to airports, concerning the enhancing growth potential of a region as they assure accessibility that allows businesses to develop [5].

As the seaports did in the 18th century, railroads in the 19th, highways in the 20th, commercial airports are driving and shaping the business location and industrial development in the 21st century, creating new economic geography [6: pp 2].

A concept was developed by Dr John Kasarda to keep up with all this growth and evolution, called Aerotropolis.

To understand this concept, one can see that over the years, the airport was made to serve the city, but as seen in Figure 1.1, the evolution of air transport has changed the scenario, which has boosted the idea of building cities around the airport. Thus, this is the reason why there is a need to create or adjust, in some cases, the Aerotropolis, where the main goal is to facilitate activities related to air transportation, whether commercial or personal.

This work is aimed at a specific zone, Faro International Airport (Figure 1.2). The objective is to reach a plan to adjust this zone into an Aerotropolis making it a case study where we will find out if it is possible to implement this concept, since "In the absence of a capable and effective implementation organization, even the best Aerotropolis development strategies and plans will fail" [7:pp 1].

Figure 1.2 - Faro International Airport, 2016.
Source: [8].

Over the years, many airports have chosen this approach, such as Amsterdam Zuidas or Paris Charles de Gaulle, therefore good examples to follow to develop an airport into the desired cluster properly.

In this case, we are going to consider a pre-established Catchment Area to determine how we can improve such area to fulfil our interests and work that area over the years to see how the airport influenced the activities of the region.

Generally, we must say that becoming an Aerotropolis does not represent a solution to a specific problem. It is an evolution towards a more efficient way of life because it makes easier the connection between peoples and goods around the airport, which is vital at a time when the impact of air transport on society is increasing, and according to what statistics indicate, it will continue to do so.

1.2 Object and Objectives

The main objective of this dissertation is to develop an Aerotropolis plan to apply in Faro International Airport, leading to better efficiency.

There will be different specific objectives in this work:

- The first one is to identify the different types of business that exist in the airport's Catchment Area due to the existence of the airport;
- The second one is to trace the growth of such business in this area throughout the years using the software ArcGIS, creating a database with information that will allow knowing where and when different businesses were created or moved within the airport Catchment Area;
- The last one is to compile that information and determine whether it is possible to adapt this airport into an Aerotropolis.

Faro International Airport will be the object of the case study in this work.

1.3 Methodology

The methodology that will be used in this dissertation consists of studying in detail the State of the Art, specifically the literature mentioned in that chapter.

From there, a more practical approach is made with the use of software and analysis of the evolution that occurred in the airport Catchment Area.

Considering this basis and following the Aerotropolis concept, different layouts will be tested to assess the possibility of having one in this region.

In Figure 1.3, a flowchart details the methodology process, which is the foundation of this dissertation.

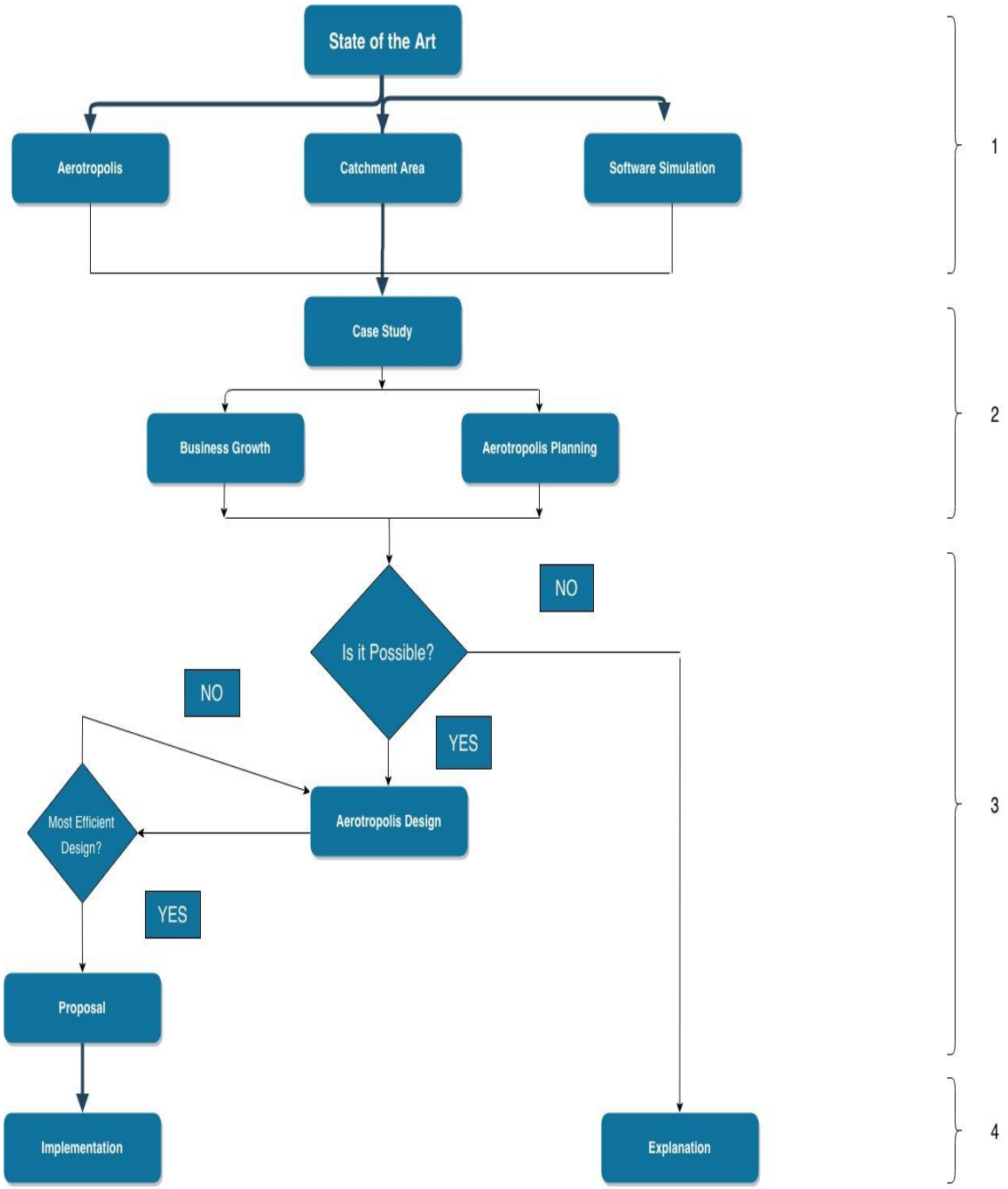

Figure 1.3 – Methodology Flowchart.

Source: Own elaboration.

As we can see from the flowchart, in Section 1, a further study of state of the art will be made to gather every information and understanding of the subject.

In Section 2 there is the case study, where the study of the business growth in the Catchment Area is conducted, and in parallel, the study of planning and development of such model, which is key to accomplish the main objective.

Section 3 is where the findings of the research will allow whether it is possible to transform the designated airport into an Aerotropolis. If that option turns out to be positive, then we design a possible model for the airport and improve it until it is the most efficient it can be.

Section 4 is about the proposal; creating one from the most efficient solution and after that, try to implement that proposal if possible with the local authorities.
However, if we have a negative outcome in Section 3, and therefore determine it is not possible to adapt to an Aerotropolis, an explanation about what will be the objective of the dissertation.

1.4 Dissertation Structure

This dissertation is divided into five chapters.

The first chapter is the work introduction and presents the motivation, the main object, specific objectives and the dissertation structure.

In chapter two, a state of the art review is done, focused on what surrounds the Aerotropolis concept, like the origin, planning, layout, examples and industry. Also, includes a review of Catchment Area and the software ArcGIS.

The third chapter contains the case study - Faro International Airport Catchment Area - and the application of the ArcGIS software and data information. Working these tools will enable us to create a plan of the Aerotropolis objective.

An analysis of the results will be drawn in the fourth chapter, with the possible solutions for the case study in hand.

In the fifth chapter, the conclusions are presented, including a summary of the dissertation, final considerations and future perspectives.

Chapter 2 – State of the Art

2.1 Introduction

In this chapter, a state of the art review is made focusing on Aerotropolis, several approaches to the concept and related topics such as planning, layout, industry and some examples. Also contains description and method to determine the Catchment Area and the software ArcGIS. Some insights into the regional characteristics are shown in the context of the previous concepts.

2.2 Aerotropolis and Airport City

2.2.1 Concept

Aerotropolis is a concept that first came in 1939 by the hands of Nicholas DeSantis, a commercial artist from New York. He elaborated an illustration, as seen in Figure 2.1.

Figure 2.1 - Skyscraper Airport for City of Tomorrow.
Source: [9].

This plan took five years of studying and consisted of a skyscraper 200-stories high capped by an aeroplane field eight city blocks long and three blocks wide. Commuters living 100 miles or more from the city would use private planes to fly to work. Landing on the roof, they would descend by elevators and moving platforms to an indoor parking space for 250,000 personal cars and taxis, whence they would be moved directly to their destination [9].

Throughout the years, Aerotropolis was used in different ways, like H. Mckinley Conley in the 1970s and later by Dr John Kasarda.

Traditionally airports have been located 15 to 30 kilometres away from their corresponding city, mainly for air transport purposes, and they lack high relevance to the economy in their neighbourhood areas [10].

A new urban form is emerging "The Aerotropolis", facing these facts, as more and more aviation-oriented are being drawn to airport areas. Transportation corridors are radiating from the Aerotropolis extending up to 30 kilometres outward from the major airports [11].

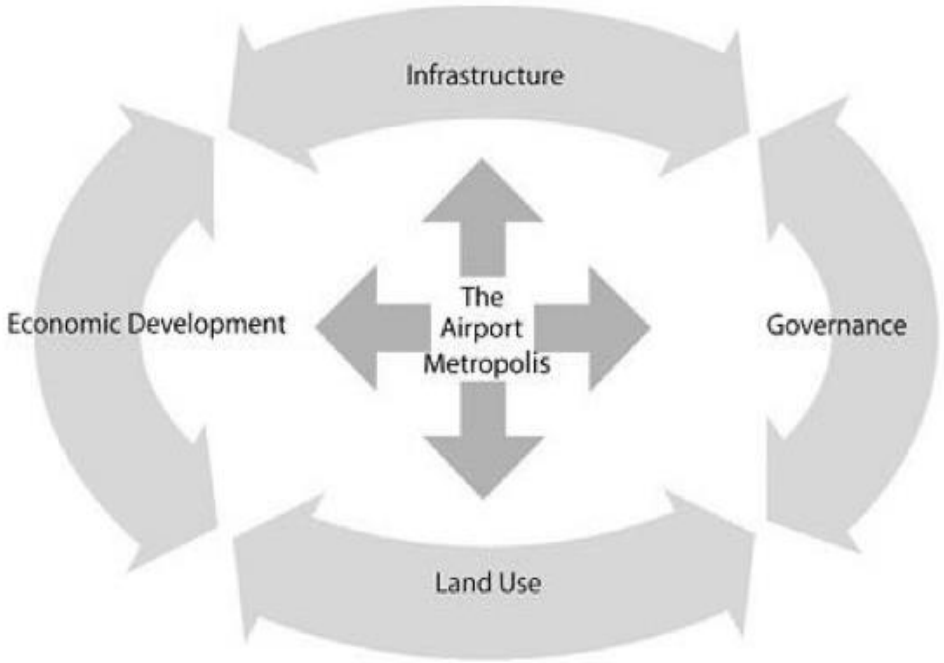

Figure 2.2 - The airport metropolis interface model.
Source: [6: pp 11]

An Aerotropolis is considered a metropolitan subregion whose infrastructure, land use and economy are centred on an airport as displayed in Figure 2.2. It consists of an airport aeronautical, logistics and commercial elements, and it connects transportation infrastructure with clusters of aviation-oriented businesses and residential developments that continually feed off each other and their proximity to the airport [12].

In recent years, there has been an evolution in airport cities with different spatial forms projected on available land and ground transportation infrastructure. Virtually, this emergence is a response to four essential factors [13]:

1. Airports need to create new non-aeronautical revenues;
2. The commercial sector's search for accessible land;

3. The increased passengers and cargo flow generated by gateway airports;
4. Airports are serving as a catalyst for landside business development.

The key value of Aerotropolis is that it offers businesses fast connectivity on a massive scale. Aerotropolis corporations, several in the high-tech and advanced business-service sectors, are often more dependent on distant suppliers, customers and enterprise partners than those located in their metropolitan region. For these companies, time is cost, and it is also a currency. By providing these firms with rapid long-distance accessibility, the Aerotropolis helps them cut costs, increase productivity and expand market reach, thereby becoming more competitive and collaborating more effectively in the international division of labour.

Metropolitan and regional trade in high-value goods and services is accelerated through airline routes that operate as a "physical Internet", moving products and people rapidly over long distances, just like the digital Internet moves data and information [12].

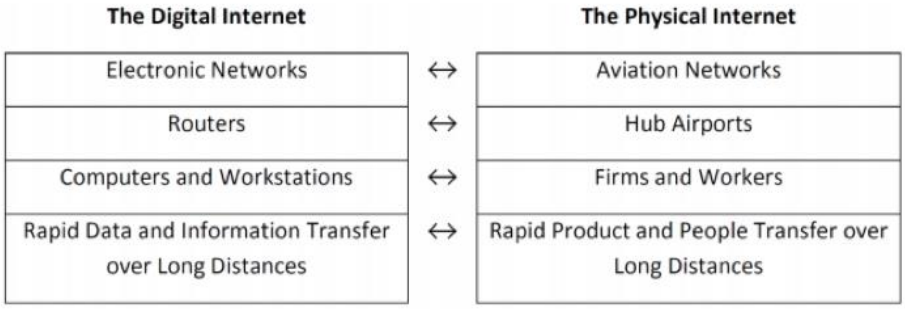

Figure 2.3 - Analogous Components of the Digital and Physical Internet.
Source: [11].

As shown in Figure 2.3, domestic and international air routes coalesce into aviation's World Wide Web, operating as a "physical Internet", described before, analogous to the way the digital Internet moves data and information [11].

Hub airports and their surrounding areas set the scene where the concrete interfaces and the global meets the local in international people and product flows. Their twin roles as airline network routers and global-local interfaces are making these airports and their environs business magnets and urban economic catalysts as they attract, sustain and grow aviation-dependent companies [11].

Various concepts related to the shapes manifestations of these developments are found in literature as "Airport City", "Airport Corridor" and of course "Aerotropolis" [14].

The urban form must show the main features of a city such as density, access quality, environment and services, to qualify as an Airport City. If it does not meet these criteria, the

economists disregard this urban form and define Airport City as a cluster of economic functions at the airport and around it [15].

As for the Airport Corridor, the literature says that when exists a planned and integrated real estate development between the airport and the city, where urban development occurs alongside major surface infrastructure, there is an Airport Corridor [16].

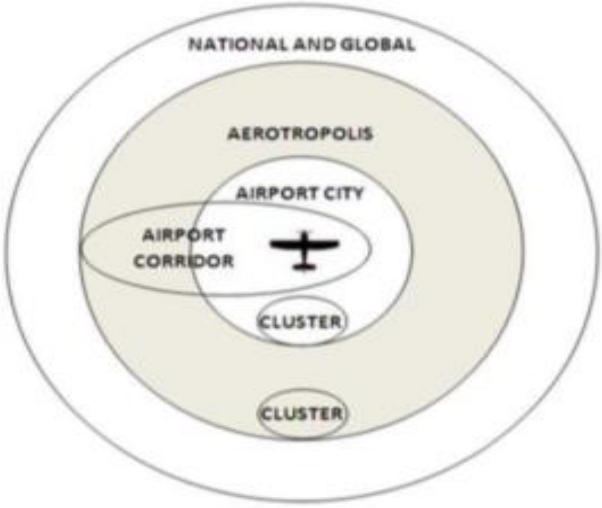

Figure 2.4 – Airport-centred urban development concepts.
Source: [15].

The urban development's concepts that are airport-centred are shown in Figure 2.4. Inside the Airport Corridor, there are functions located within this space that is connected to essentially five markets [15]:

1. Passengers: airport terminals, hotels, retail;
2. Airport employees: housing, services;
3. Air cargo: logistics parks;
4. Business community: office and technology parks, conference and exhibition facilities, hotels, golf courses, expat housing;
5. Passengers-visitors: tourism, leisure, entertainment, health, education, theme parks, casinos, clinics, shopping malls, sports stadiums, universities.

There are four critical factors for the development of airport cities. These factors should not be regarded as independent from one another [15]:

1. Connectivity: Related to physical infrastructure providing unrestricted access to and from the airport;
2. Economic Potential of the Catchment Area: Airport city operators need to select functions that are compatible with the economic profile, labour supplies and location of their catchment areas;

3. Commercial Attitude of the Airport Operator: In this context, the airport operator is independent of the structure ownership. It is represented by the operator's activities, aggressive marketing strategies and pro-active land acquisition for real estate development;
4. Sustainable Development Context: This is the broadest factor that includes political prioritisation, minimisation of externalities and capture of spin-off economic benefits.

2.2.2 Planning

One of the most vital things in Aerotropolis is planning because it needs to be well thought out and designed to achieve its goals.

Aerotropolis master plans to date have mostly consisted of elaborations of proposed commercial land use and urban design renderings, along with recommendations airport transportation infrastructure to improve region surface. Much less attention has been given to the strategic, economic and real estate investment issues that determine whether proposed Aerotropolis commercial development would occur. Thus, in addition to land use and transportation planning and urban design (including environmental and community elements), and effective Aerotropolis master plan must also be both an economic plan and a strategic, that articulates the drivers of and barriers to Aerotropolis development, as well as provide data-based assessments of commercial real estate demand for various Aerotropolis functions and sites. Five planning requirements are focused upon [17]:

1. Local and regional market demand for air commerce;
2. Sufficiency and efficiency of air and ground connectivity;
3. Incorporating customers and stakeholders want and need;
4. The management of commercial real estate development;
5. Attract investors and investments.

Since the fifth factor is so essential for Aerotropolis development success, planning strategies and actions to attract investors who make financially viable commercial real estate investments receive the most significant attention [17].

Addressing each one of the elements above individually, we can state that concerning the market demand for air commerce, planning must start with a detailed understanding of the existing economic base of the airport's catchment area.

The reason for its status is the growth potential. Which industries already own a location there? Are there time-sensitive manufacturers and distribution companies? How are local manufacturers' supply chains provisioned both upstream and downstream? Are they users of

air transportation? What is the mix of shipments (by harmonised code, weight, value, destination, and shipment frequency) that make up the airport's cargo volumes? What are the operational impediments aviation-oriented firms face that can be resolved in conjunction with the airport, the community, the private sector, and government?

When we talk about connectivity, we must understand that businesses are attracted to an airport area because of the quality of its connectivity, both air and ground. Good multimodal connectivity allows Aerotropolis companies to save time in interacting with their suppliers, customers, and enterprise partners, especially those at remote sites. Investors, commercial real estate developers, and facility end-users, often in consultation with site selection enterprises, inevitably test the airport area's local and longer-distance physical connectivity before making decisions about investing in or locating new operational facilities there. The Aerotropolis development team should, therefore, be prepared to explain the airport region's multimodal connectivity and its advantages over other investment sites. In addition to providing the specifics for this explanation, the master plan must articulate the steps and strategies that will further improve the airport region's air and ground connectivity [17].

Stakeholders are a vital part of the Aerotropolis planning for apparent reasons, but we must keep in mind that Engaging stakeholders is one thing, and Aligning them is another much more difficult task. Without stakeholder alignment, execution of a planned Aerotropolis development will face continuous barriers. Accordingly, the significance of this task in the Aerotropolis master plan cannot be overstated.

The management of the real estate development in an Aerotropolis is an essential yet complex challenge that requires a long-term planning perspective, specific skills and experience, and a willingness to adjust to the needs of investors, developers, and their business tenants [17].

Finally, attracting investors seems something casual, but one must understand that Aerotropolis investors encompass a wide gamut of companies and other entities: banks, private equity and investment funds such as real estate investment trusts (REITs), public-private partnerships, sovereign wealth funds, and multilateral financial institutions like The World Bank, along with governments of all levels. Without their investments, little or no development occurs. For this reason alone, strategies and recommendations for enticing investors and investment are necessary components of any effective Aerotropolis master plan [17]. In Figure 2.5, it is possible to see a schematic of the Aerotropolis planning, and all that includes.

Figure 2.5 - Ring of Aerotropolis Integrated Planning.
Source: [11].

2.2.3 Layout

A layout was created by Dr John Kasarda, to validate this concept, and although no Aerotropolis will look like this, most will adopt similar features.

It is important to understand that the Aerotropolis must be a dynamic model, instead of a static one, that is what makes it efficient.

The Aerotropolis also encompasses living urban places that must be designed as appealing environmental and social realms, if the model is to achieve its full potential [7].
Some key points pave the way to make the model functional and make it possible to achieve a close to the optimal model.

These points, together with an illustration of the Aerotropolis model, can help us see what the main goal is [7]:

1. Dedicated airport expressway links (aero lanes) and airport express trains (aero trains) should efficiently connect airports to major regional business and residential concentrations;
2. Special truck-only lanes should be added to airport expressways, as should improve interchanges to reduce congestion;
3. Time-cost accessibility between key nodes should be the primary Aerotropolis planning metric rather than distance;
4. Businesses should be steered to locate in proximity to the airport based on their frequency of use, further reducing traffic while improving time-cost access;

5. Airport area goods-processing activities (manufacturing, warehousing, trucking) should be spatially segregated from white-collar service facilities and airport passenger flows;
6. Noise and emission-sensitive commercial and residential developments should be sited outside high-intensity flight paths;
7. Cluster rather than strip development should be encouraged along airport transportation corridors with enough green space between clusters;
8. Form-based codes should establish general design standards for airport area buildings, walkways, travel lanes, landscaping, and public space;
9. Placemaking and wayfinding enhanced by thematic architectural features, public art, and iconic structures should make Aerotropolis developments interpretable, navigable, and welcoming;
10. Mixed-use airport area workers residential/commercial communities housing and frequent air travellers should be developed with easy commutes and designed to human scale providing local services, urban amenities, and sense of neighbourhood.

Therefore all translates into an Aerotropolis model that follows (Figure 2.6). Thus, this is a thought-out schematic of what an Aerotropolis should look.

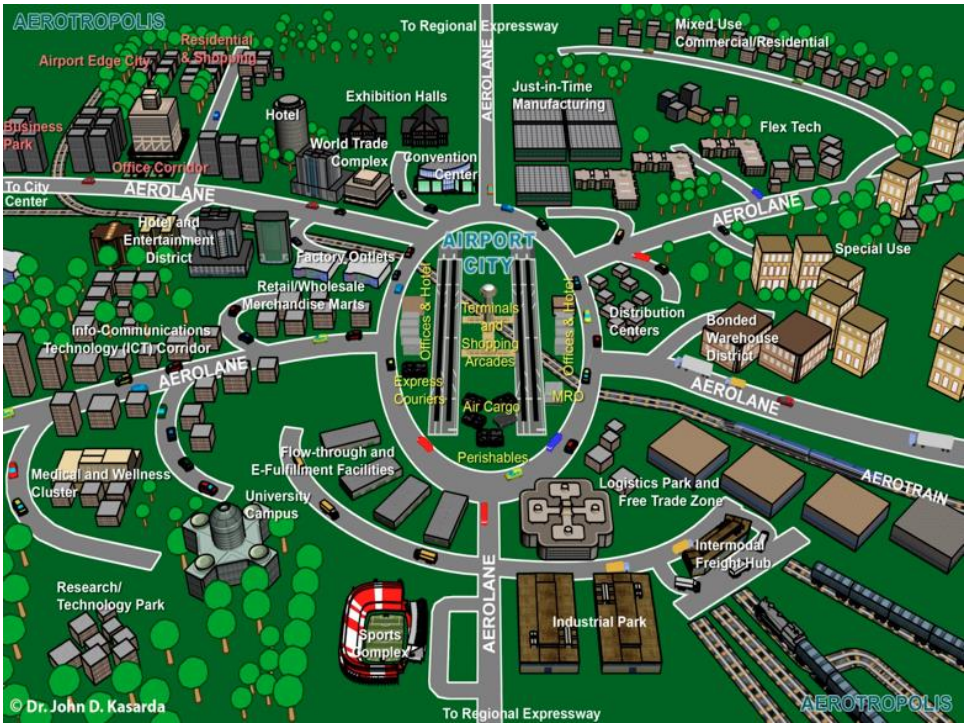

Figure 2.6 - Aerotropolis Schematic.

Source: [7].

In Europe, we have some examples already operational, like Amsterdam and Paris Charles de Gaulle airports.

In both Aerotropolis examples, studies were made and determined the length of the areas relevant to the model, areas that we can show in the next Figures 2.7 and 2.8, respectively.

Figure 2.7 - Amsterdam Airport Schiphol.
Source: [18].

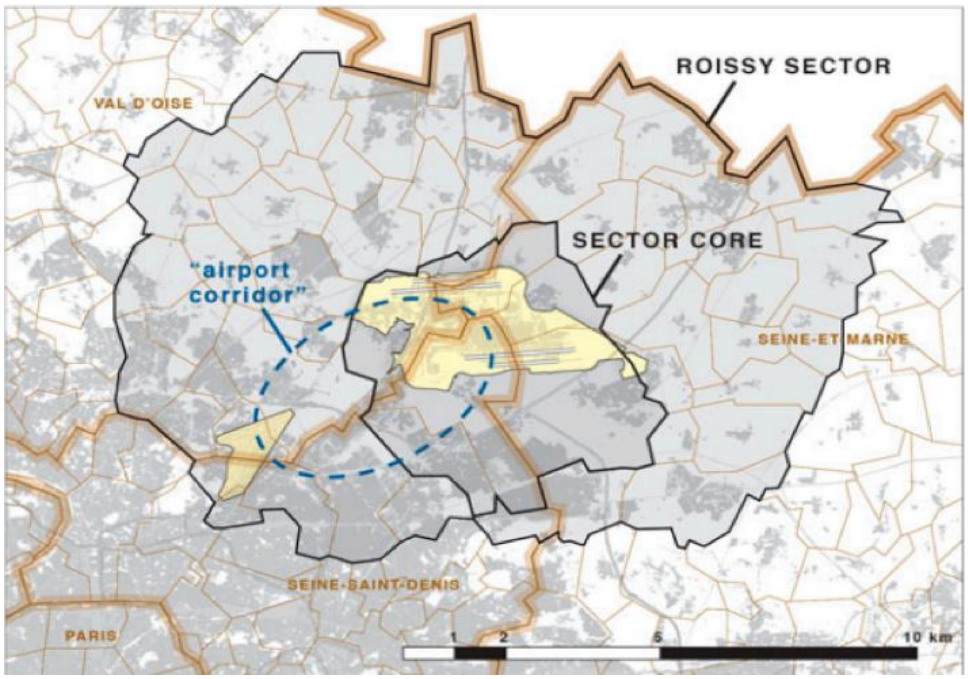

Figure 2.8 - Paris Charles de Gaulle.
Source: [19].

2.2.4 Industry

The employment scale and business mix of the Aerotropolis are far higher than many realise. A research conducted by Dr. Stephen Appold and Dr. John Kasarda on employment around the 25 busiest passenger airports within the U.S., found that: 3.1 million jobs as of 2009 were located within a 2.5-mile radius of these airports (2.8% of total U.S. employment); over 7.5 million jobs within a five-mile distance (6.8% of all U.S. employees) and 19 million jobs (17.2% of the U.S. total) within 10 miles (Figure 2.9). Appreciation of wages and salaries in these airport radii showed that the respective percentages from payrolls were 3.4%, 8.2% and 21.9%. Thus, this indicates that many jobs near major airports are relatively well paid [20].

In the European case, and looking more specifically for the examples mention before, in the Paris Charles de Gaulle airport this adaptation led to the creation of 248 000 jobs, representing 6.1% of the salaried jobs in the Paris Region [19]. In Amsterdam, the number of jobs created is 65 000 [18].

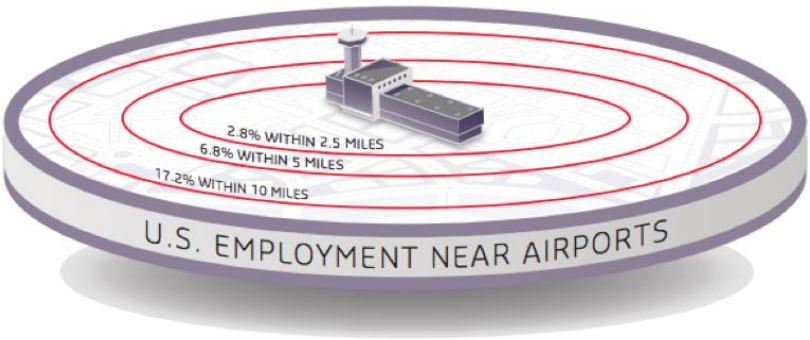

Figure 2.9 - U.S. Employment Near Airports.
Source: [20].

As this research demonstrates the importance of Aerotropolis in the economy, Figure 2.10 shows the non-airline profits that are directly influenced by it.

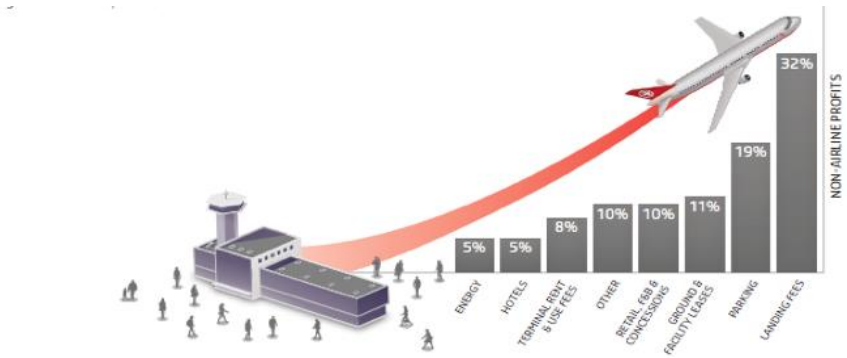

Figure 2.10 - Aerotropolises as Economic Accelerators.
Source: [20].

In this sub-chapter is given the U.S. example to show the importance of the model in today's economics, because although we have some examples in Europe, the U.S. seems more developed at this time. In Portugal, this approach has yet to be used, and as said before, one of the objectives of this thesis is to change that view and get closer to evolution to this concept using one specific airport.

2.3 Catchment Area

2.3.1 Introduction

The Catchment Area of an airport is a term that has an extensive definition, and that is why current literature prefers to do it in combination with specific pre-defined criteria: the assessment of the impact of the effectiveness of a specific airport, or from a perspective of competition between airports. The base of each one of these definitions is the different analysis of the airport infrastructure depending on whether it is of passengers or cargo [6: pp 7].

In terms of human geography, the definition of Catchment Area is the area and population from which a city or service can attract visitors or costumers [21]. This chapter presents the definitions from several authors.

There is a direct relationship between an airport Catchment Area and the geographical reach of the airport services to the surrounding population and economy they serve. The concept of Catchment Area is a geographical zone containing the potential users and passengers for the airport infrastructures [22]. In other words, is the area to which most inbound passengers are travelling, or from which most outbound passengers have originated [23], [24].

There are many concepts to define the catchment area, and they include several typologies, as described by J.H. Bird in 1971:

1. Immediate Catchment Area: refers to the airport area itself;
2. Primary Catchment Area: is the area where the airport and the city assume a commanding role in the life of that area;
3. Commodity catchment area: is the area based on the shipment of types of commodities;
4. Inferred Catchment Area is the airport hegemony over an area that satisfies the demand for the area it serves.

Catchment Areas are traditionally simple to represent in a spatial form, either by drawing concentric circles of travel distance around the airport as seen in Figure 2.11. Another way to represent it is based on an arbitrary assumption of maximum travel time from any given point to the airport, as displayed in Figure 2.12.

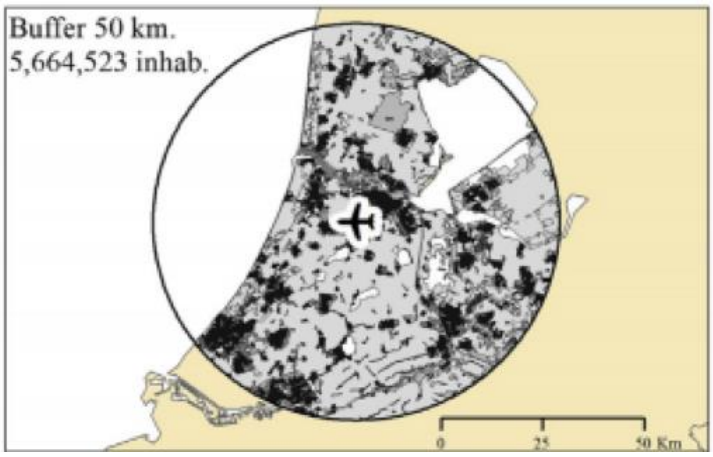

Figure 2.11 - Fixed radius Catchment Area.
Source: [25].

In this case, Kasarda defines Aerotropolis as 25km from the airport [26]. Different authors use a broader interpretation on the same approach as they define the Aerotropolis as 50km from the airport [27], as a city-port size for Europe [28] or even 100km from the airport [29].

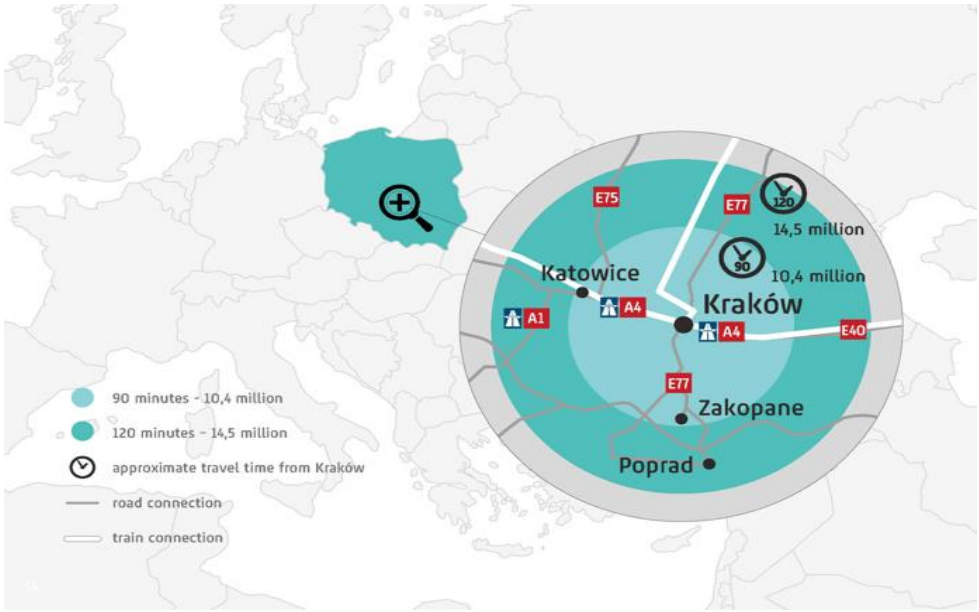

Figure 2.12 - Catchment Area – Travel Time.
Source: [30].

The estimated Catchment Area of any given airport is everything that locates within a 2-hour drive time by car, using travel time approach [31]. Typically, a 1- or 2-hour drive is defined

for a primary catchment area, while isochrones of longer time may be considered to represent a secondary or tertiary catchment area [32].

The European Commission established, in 2012, a 100km distance radius or 1-hour driving time as an airport's common catchment area [33].

The previous approaches seem easy to apply and interpret. However, they have some concerning issues [34]:

1. The result is a static image of an airport Catchment Area. Changes in the factors that drive the passengers to choose an airport do not affect the size of the Catchment Area;
2. The market shares in the catchment area remain unclear. Thus, this ignores the fact that the market shares tend to decrease when moving further away from the airport;
3. The catchment area is assumed the same for every destination. Thus, this appears unrealistic because an airport that offers a higher level of destinations may attract passengers from regions over 2h away.

The analysis and evaluation of a Catchment Area can be a useful tool regarding an airport's passenger base, inherent strengths, and it is also done with several socio-economic indicators as depicted in Table 2.1, it is, although, essential to note the difference between catchment area and geographic market (market share).

Catchment Area analysis is a way to estimate the geographic area from which an airport can attract passengers, while geographic market analyses the area over which passengers would substitute to another airport considering a small increase, of 5% to 10%, in the price level of the original airport [34], [35].

Table 2.1 – Socioeconomic Indicators

Source: [6]

INDICATOR	DISCRIPTION
Population Density	Population density is expressed by the ratio between the population and the surface area, usually applied to human beings, but also in other living beings (commonly, animals). It is usually expressed in inhabitants per square kilometer
Education Level	It is a ratio between the inhabitants with higher education level by the total number of inhabitants
Household Income	Average income per capita by month (in euros)
Economically Active Population	It is the fraction of a population that is either employed or actively seeking employment. Is measured by the ratio between the economically active populations by the number of inhabitants
Employment Level	The employment rate is one of the economic indicators that economists examine to help understand the state of the economy. Is measured by the ratio between the numbers of employees by economically active population
Companies Density	It is the number of companies by square kilometer
Sectorial Structure of Employment	Is the number of employed people by the total of companies from the sectors (industrial, real estate, and housing)
Business Volume	Is measured as a GDP (Gross Domestic Product) density
Health	It is the number of doctors by square kilometer
Tourist Attractions	Tourist attractions are measured by the number of attractions by square kilometer. Includes museums, golf camps, zoos, botanic gardens...
Hotel Establishments	Hotel establishments is the number of hotels; apart hotel; guesthouses; motels; hostels; tourist villages, by square kilometer
Accommodation Capacity	Is measured as the number of beds available in hotel establishments
Occupation Rate	Is measured as the ratio between the numbers of beds occupied, in hotel establishments, by the number of beds offered

2.4 ArcGIS

ArcGIS is a geographic information system (GIS) for working with maps and geographic information. It is used for creating and using maps, compiling geographic data, analysing mapped information, sharing and discovering geographic information, using maps and geographic information in a range of applications, and managing geographic information in a database [36].

The system provides an infrastructure for making maps and geographic information available throughout an organisation, across a community, and openly on the Web.

ArcGIS is a proven tool in managing data, model new scenarios and create easy to understand scenarios for growth and management. It has extended visualisation capabilities (2D and 3D for new insights), automate quality control, and this is why it is used in airports all over the world [37].

The software is used in the most diverse industries to help planning and to monitor such as [38]:

1. Telecom and network services;
2. Urban planning;
3. Transportation planning;
4. Environmental impact analysis;
5. Agricultural planning;
6. Land use planning;
7. Surveying;
8. Community development;
9. Fire equipment response analysis;
10. Energy use tracking and planning;
11. Forest fires hazard zone mapping and planning;
12. Traffic density planning;
13. Space utilisation planning;
14. Disaster and business community planning;
15. Regional planning.

In Phoenix Sky Harbor International Airport, one of the ten busiest airports in the world, they use ArcGIS as they were in "(…) need for an enterprise-class information system to support changes from planned development" [39: pp 1]. Most of the staff who use this tool in Phoenix are not GIS specialists or technicians. However, they all use the system quickly to build maps (Figure 2.13) or plan maintenance works [39].

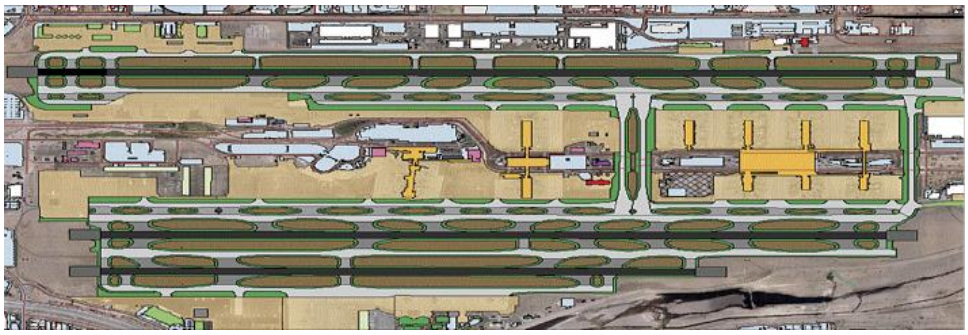

Figure 2.13 - Phoenix Sky Harbor International Airport.
Source: [39].

2.5 Conclusions

This chapter describes several subjects pertinent to the dissertation as the description of the state of the art.

Beginning with the Aerotropolis concept and how has changed over the years, followed by the planning of an Aerotropolis all that includes, it also features layout strategies, socio-economic indicators and the state of the industry in the world. In this work, the main goal is to conduct an investigation that leads to possible implementation of an Aerotropolis-like model in Faro, so a description of Catchment Area is made within this chapter containing definitions and evaluations of this topic concerning Airport City and Aerotropolis.

Finally, an introduction is made to the software used, ArcGIS, highlighting the advantages that this tool can provide to this dissertation and similar works.

According to the flowchart 1.3, the revision of the state of the art in the three mentioned topics (Aerotropolis, Catchmente Area and Software simulation), were accomplished.

Chapter 3 – Case Study

3.1 Introduction

This chapter describes the methodology and results to determine the viability of an Aerotropolis in the Algarve region, with Faro International Airport being the main object of the dissertation. It shows a determination and evaluation of the airport Catchment Area, which includes a GIS approach and a consideration of the socio-economic indicators within the Area. This chapter only shows the results obtained for the Faro International Airport; furthermore, there will be a discussion of the results.

3.2 Catchment Area Determination

An airport Catchment Area is determined using an estimated travel time from any given point to the airport, using a conventional GIS approach.

As said before, the GIS (Geographic Information System) is a software, spatial data and computational procedures system that enables and facilitates the analysis, management and representation of space and phenomena that occur in it as shown in Figure 3.1. GIS has several applications; one of them is the possibility to be used as a database with geographic information (alphanumeric data), associated with a common identifier to graphical objects in a digital map. Thus, this allows us to know the attributes of an object by marking it, and from there, select a record from the database to know the location and pinpoint in on a map [6].

The Geographic Information System (GIS) can separate information into different layers and gather them independently, making it possible for the user to relate the information through the existing position and topology of objects, with the order to generate new information. The GIS raster (or matrix) and vector model are the most common models. The model matrix focuses on the properties of space (usually square, but can be rectangular, triangular or hexagonal) regular cells, where each cell represents a single value. The size of the cell measures the accuracy or detail in the representation of geographic space, meaning that the bigger the cell, the lower the accuracy.

The GIS vector model is slightly different as this retains the focus of representation on the accuracy of the location of the elements in space. Entities are used primarily, to digitally model the real-world, by three spatial forms: point, line and polygon [40].

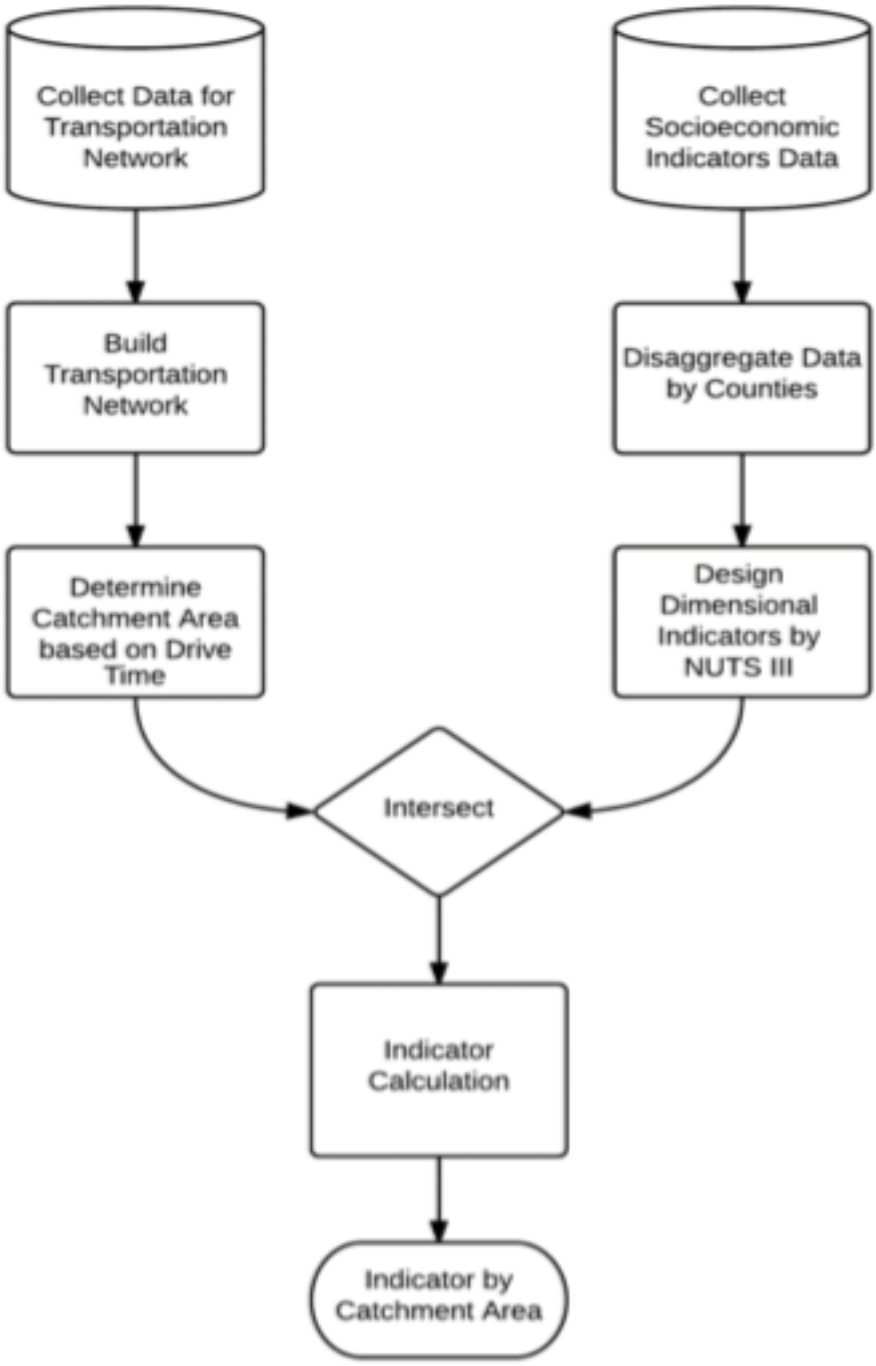

Figure 3.1 – GIS workflow.

Souce: [6:p.26].

The Portuguese routes speed limits are taken into consideration, to determine the Catchment Area, defined by the authorities to create the transportation network with GIS. The speed limits stand at 120 Km/h on highways, decrease to 100 Km/h in Principal Itineraries, 90 Km/h in Complementary Itineraries and 50 km/h on other itineraries such as within city limits per ANSR.

A transportation network is built around a perfect and ideal scenario with the following assumptions:

- The speed considered is the maximum speed allowed;
- Travel speed is considered constant;
- It does not consider the acceleration time needed to get to speed reference;
- The resulting Catchment Area does not evolve extra time (static image);
- Catchment Area determined is the same for every destination offered by the airport;
- It does not consider speed limitations in specific situations as tunnels, residential roads and roads inside towns.

According to Portuguese Authorities (ANA), the travel time considered to determine the Catchment Area is 60 minutes for Faro Airport (FAO). Now, using the transportation network map (Figure 3.2) and applying the 60-minute drive, it is possible to design the Catchment Area, as seen in Figure 3.3.

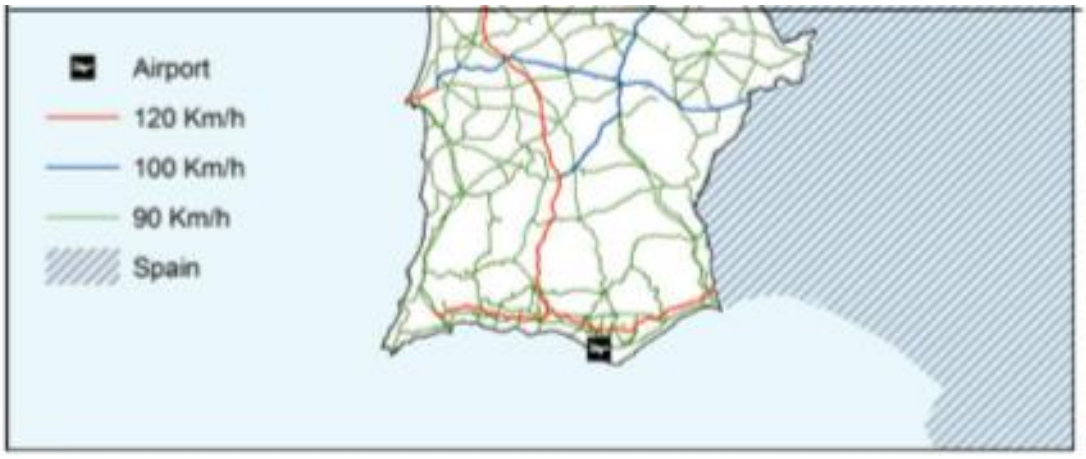

Figure 3.2 – Transportation Network.

Source: [6]

Figure 3.3 – Faro Airport Catchment Area (60-minute travel).

Source: [6].

3.3 Catchment Area Evaluation

The evaluation of the Catchment Area is made considering the socio-economic indicators of the region (Sub-chapter 2.3).
The indicators that were subject of analysis are Population Density, Education Level, Household Income, Economically Active Population, Employment Level, Companies Density, Sectorial Structure of Employment, Business Volume, Health, Tourist Attractions, Hotel Establishments, Accommodation Capacity and Occupation Rate. All these indicators are described thoroughly on Sub-Chapter 2.3.

From the previously established Catchment Area, there are twenty counties within those limits. Those counties are the ones where all the indicators will be evaluated and object of a study to assess the evolution throughout the years. The counties are the following:

- Albufeira;
- Alcoutim;
- Aljezur;
- Aljustrel;
- Almodôvar;
- Castro Marim;
- Castro Verde;
- Faro;
- Lagoa;
- Lagos;
- Loulé;
- Mértola;
- Monchique;
- Olhão;
- Ourique;
- Portimão;
- São Brás de Alportel;
- Silves;
- Tavira;
- Vila Real de Santo António.

All of the above will be studied within a determined period. That way, a characterisation of the region can be made using the evolution of the airport and with it the growth of the influenced counties or their decrease.
Ultimately finding out if the airport has become a source of evolution, therefore solving problems and could become an Aerotropolis.

3.3.1 Temporal Scenarios

After determining the Catchment Area, establishing the counties within the Catchment Area and setting the indicators to study, it is necessary to create a temporal scenario to monitor the variations of the significant indicators - as some additional ones - within that time frame. From the CENSUS (2001, 2011) information can be extracted to find out these changes that occurred through time. Since the next CENSUS is due in 2021, an evaluation of most indicators can be made using the last years to improve the accuracy of the study. This study must be made using the data for each county listed in section 3.3. For this reason, it is harder to compile data before 2001 of some indicators, since that data was gathered regarding NUTS I, II or III. NUTS (Nomenclature des Unités Territoriales Statistiques) is a geographical system, according to which the territory of the European Union is divided into hierarchical levels [41]. In Portugal NUTS, I contain the Mainland, Açores and Madeira, while NUTS II has seven divisions and NUTS III has 25 divisions [42].

Gathering all this data and pinpoint the variations will allow creating a choropleth map to illustrate this information and show the most influenced counties, concerning the airport location. A more thorough explanation will be made in the next chapter and complemented with tables and photos.

Figure 3.4, 3.5 and 3.6 show Population Density in 2001, 2011 and 2016, while Table 3.1 is a variation of that indicator. The rest of the indicators and its variations can be consulted in Annexe.

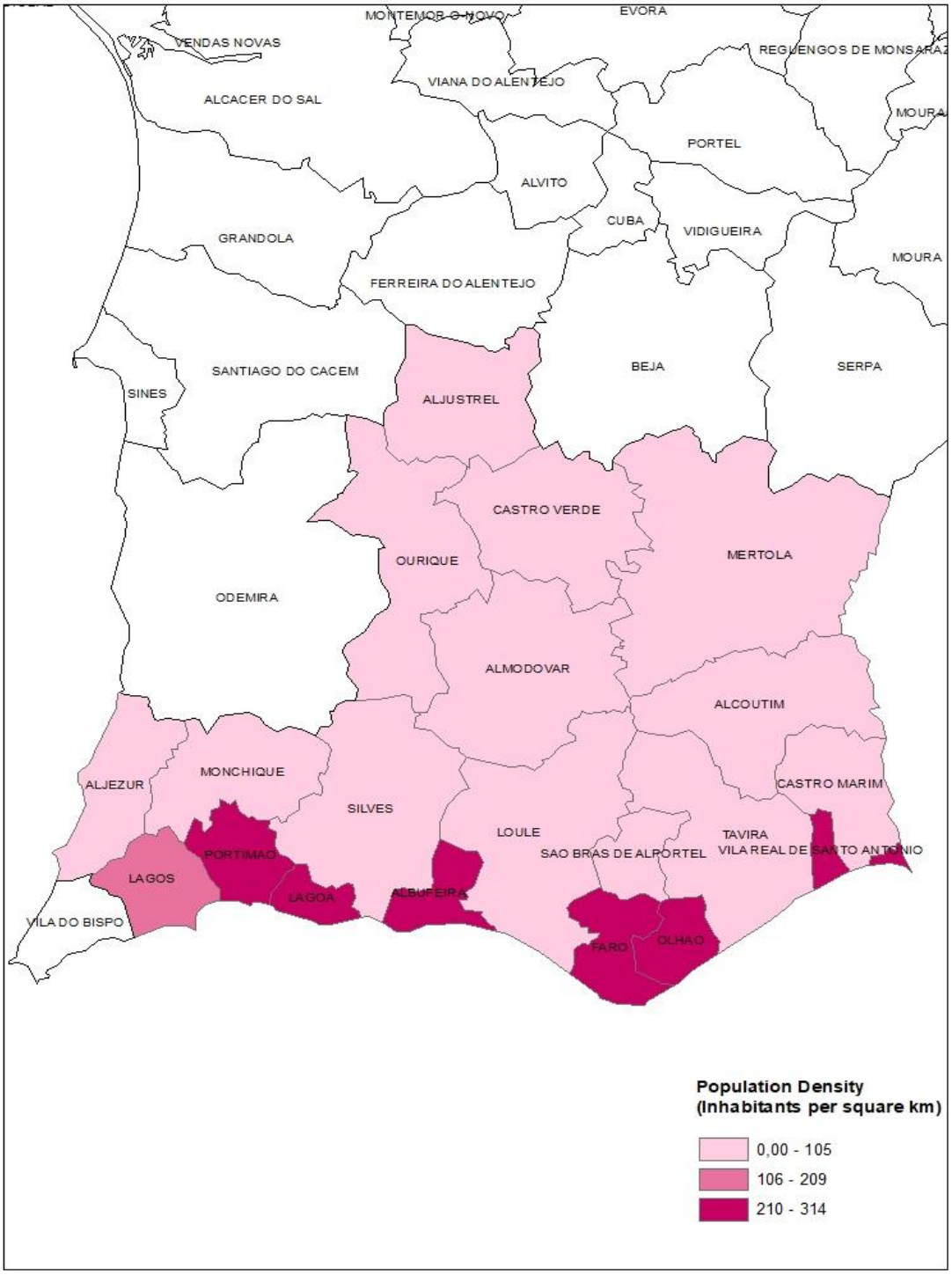

Figure 3.4 – Population Density 2001.

Source: Own elaboration.

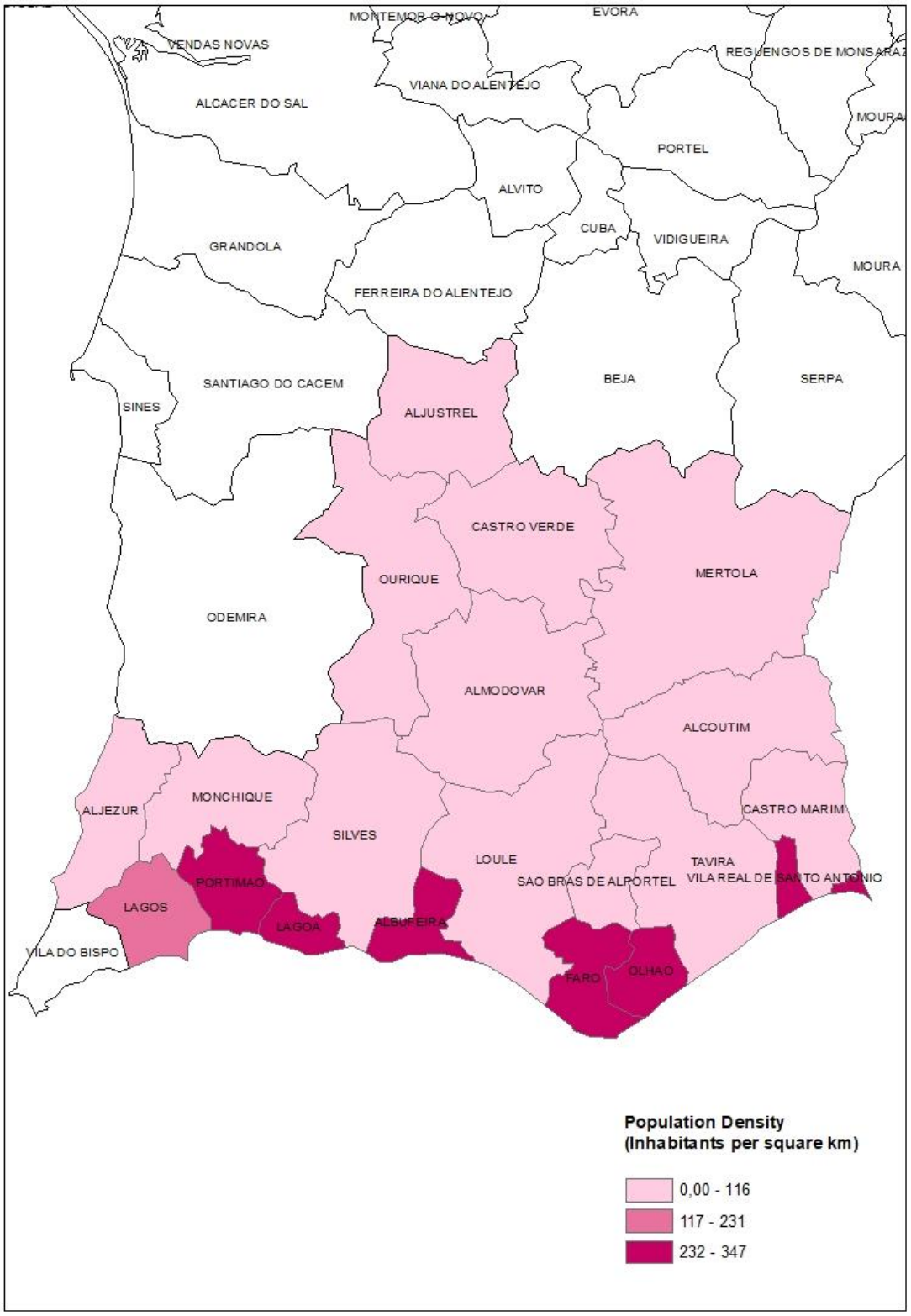

Figure 3.5 – Population Density 2011.

Source: Own elaboration.

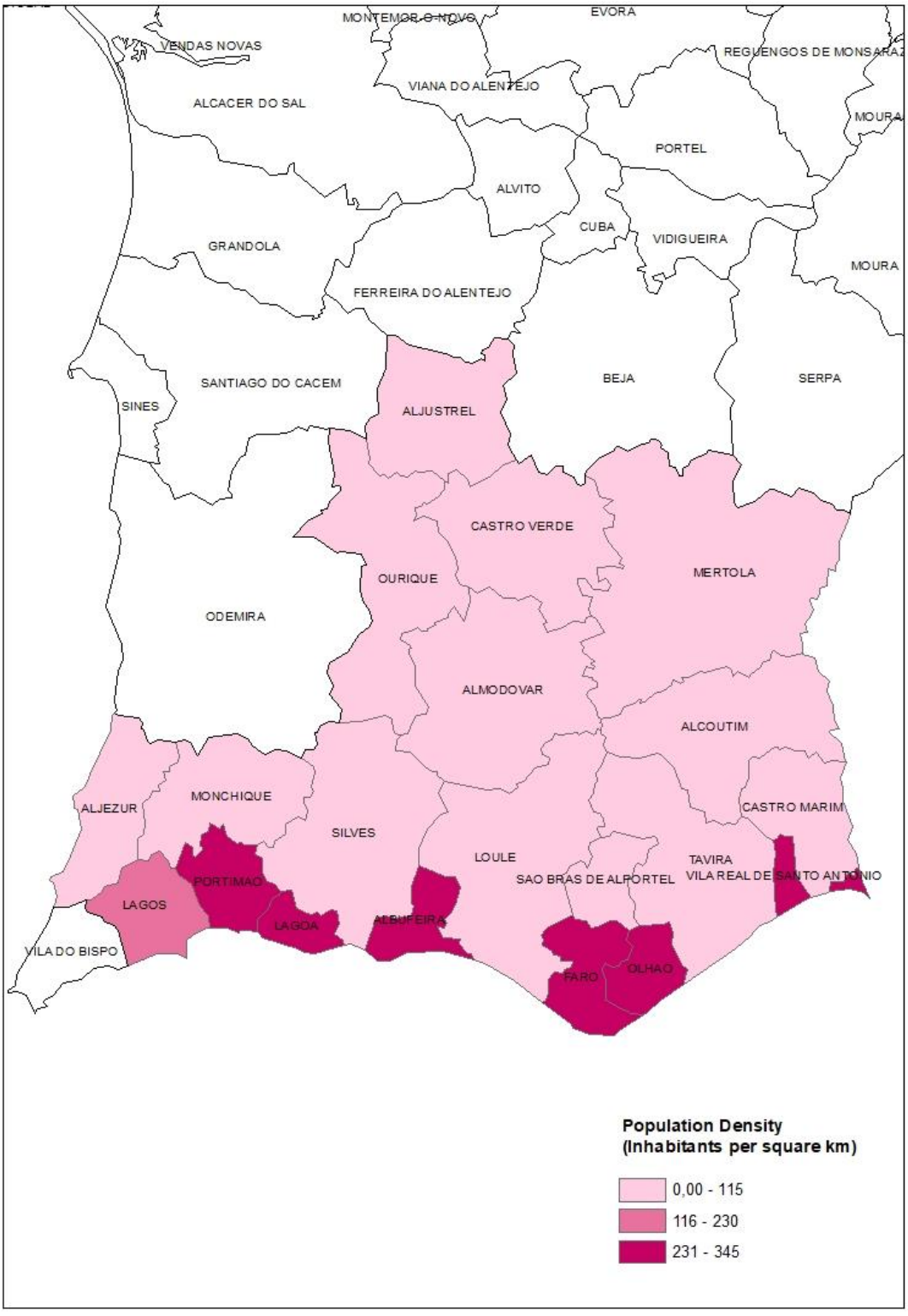

Figure 3.6 – Population Density 2016.

Source: Own elaboration.

Table 3.1 – Population Variation Density.

Source: Own elaboration.

Counties	Average n.º of individuals per Km²					
Years	2001	2011	2016	2001-2011	2001-2016	2011-2016
Aljustrel	23,1	20,2	18,6	-2,9	-4,5	-1,6
Almodôvar	10,5	9,6	8,9	-0,9	-1,6	-0,7
Castro Verde	13,4	12,8	12,5	-0,6	-0,9	-0,3
Mértola	6,7	5,6	5,0	-1,1	-1,7	-0,6
Ourique	9,3	8,1	7,3	-1,2	-2,0	-0,8
Albufeira	224,2	290,3	287,9	66,1	63,7	-2,4
Alcoutim	6,5	5,1	4,2	-1,4	-2,3	-0,9
Aljezur	16,4	18,2	17,3	1,8	0,9	-0,9
Castro Marim	22,0	22,4	21,4	0,4	-0,6	-1,0
Faro	287,2	319,8	301,4	32,6	14,2	-18,4
Lagoa	232,3	260,3	258,3	28,0	26,0	-2,0
Lagos	119,2	145,8	144,4	26,6	25,2	-1,4
Loulé	77,3	92,4	90,9	15,1	13,6	-1,5
Monchique	17,6	15,3	13,7	-2,3	-3,9	-1,6
Olhão	313,9	346,9	345,4	33,0	31,5	-1,5
Portimão	246,9	305,5	304,5	58,6	57,6	-1,0
São Brás de Alportel	66,8	69,5	68,8	2,7	2,0	-0,7
Silves	49,8	54,6	53,7	4,8	3,9	-0,9
Tavira	41,1	43,1	41,7	2,0	0,6	-1,4
Vila Real de Santo António	290,1	312,8	311,2	22,7	21,1	-1,6

A quick analysis to this table shows that Faro, where the airport is located, has always been one of top three major locations where the Population Density is higher and has grown throughout the years, except in 2016. On the other end of the spectrum, Ourique has been on bottom three both in Population Density and variation over the years.

3.3.2 Airport Evolution

Faro Airport is the third biggest airport in Portugal, making it the lowest traffic wise in Portugal mainland. This airport shares a competition zone with Lisbon airport, the busiest in Portugal and that affected the number of passengers and movements going through Faro. To boost the region through the airport, Faro airport was the first - the others being Lisbon and Porto - to operate with Low-Cost Carriers (LCC). This move represented a growth in passengers and movements, which can be seen in Table 3.2.

Table 3.2 – Number of passengers and movements from 2003 to 2013.

Source: [43].

	Passengers					Movements				
	LCCs		Others		Total	LCCs		Others		Total
2003	566236	12%	4129764	88%	4696000	4792	15%	27108	85%	31900
2004	1399528	31%	3153229	69%	4552757	13138	38%	21206	62%	34344
2005	2010655	43%	2647771	57%	4658426	17251	48%	18927	52%	36178
2006	2676064	53%	2334571	47%	5010635	21331	55%	17452	45%	38783
2007	3312780	61%	2156209	39%	5468989	23960	60%	16307	40%	40266
2008	3700375	68%	1746825	32%	5447200	25709	65%	14080	35%	39789
2009	3493334	69%	1568467	31%	5061801	23841	64%	13487	36%	37328
2010	4020252	75%	1322455	25%	5342707	27765	70%	11864	30%	39629
2011	4315649	77%	1299931	23%	5615580	29287	72%	11172	28%	40459
2012	4055356	71%	1617021	29%	5672377	26199	66%	13242	34%	39441
2013	4397475	74%	1583973	26%	5981448	28401	69%	13009	31%	41410

The table shows the market share of the LCC and other carries. In 2003, LCC only accounted for 12% of that share, although the year 2006 surpassed the 50% mark. Thus, this is a demonstration of the evolution that LCC had in this specific airport, boosting the value of the region with more movements, even though there was a slight decrease in 2008-2009 and 2011-2012. A more accurate representation of the movements and passengers by type of airline are displayed in Figure 3.5.

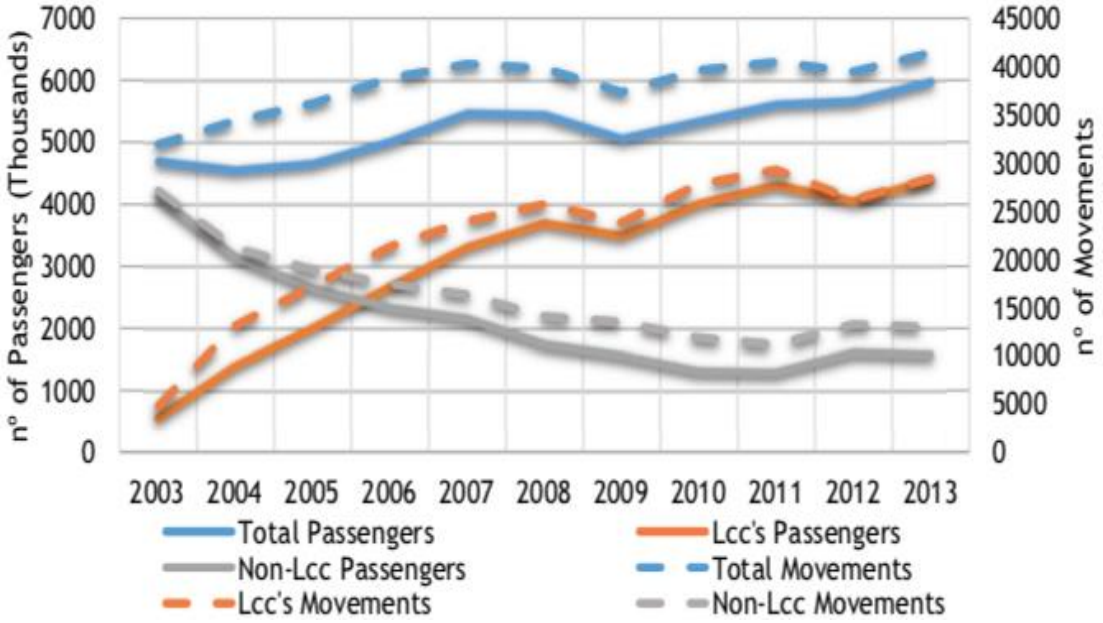

Figure 3.7 – Faro Airport passengers and movements evolution distributed by type of airline.

Source: [43].

The reduction of the non-LCC's is clear, except for the 2011-2012 period, that shows a gradual but constant reduction. The constant rise of LCC movements and passengers defines the airport change of direction, measures that came with the overall growth of the region and airport.

3.3.3 Layout

After setting a temporal scenario, the next step is analysing the layout used over the years for this Airport. This layout is something that has changed considerably since the beginning of the year 2000.

As we have seen before, this airport had considerable growth with the introduction of LCC's. What was in the past a small airport, due to low movement and passengers, had to adapt over the years to follow the growth that LCC's brought.

An aerial view of the airport over the years can be seen in Figures 3.8, 3.9 and 3.10.

Figure 3.8 – Faro Airport 2006

Source: Google Earth

Figure 3.9 – Faro Airport 2011

Source: Google Earth

Figure 3.10– Faro Airport 2016

Source: Google Earth

The importance of having these photos as references is to check the evolution that the airport layout suffered from the constant increase in movements and passengers. Also, the main goal here is to determine if these layouts became more Aerotropolis-like with the change and evolution of the airport. This airport, once seen as nothing more than just a mere checkpoint to reach Portugal, now serves a whole region and more so considering the full length of the Catchment Area. One important observation to do is if it does serve the region adequately and has the main characteristics that make it an Aerotropolis, or if it at least can adapt into one is the objective.

3.4 Conclusions

Various approaches are made in this chapter, beginning with the GIS approach to identify the counties within the airport Catchment Area, using a previous work [44]. GIS became an easy tool to use and interpret, from this building a Transportation Network was the first step, then applying it to the airport in question by using the geographic coordinates, the determination of the Catchment Area is done.This phase of the study is in line with the flowchart described in the first chapter.

After determining the Catchment Area, a data treatment of the previous established social-economic indicators is made. A study of the variation of these indicators is necessary to monitor the evolution in the region throughout the years.

Following this, a key aspect is to check the evolution of the airport itself had, concerning the movements and passengers. Moreover, by looking at those values, the next step is to overlap the airport layout, with aerial photos over the year, that allows making a thorough evaluation, whether the growth and evolution were befitting with the needs of passengers, carriers and the region itself.

Not all the information needed is available. For example, some indicators are not entirely reliable because they can be confidential; the value is yet to be reviewed or even breach of series in that report. Also, the aerial photos did not go all the way to the year intended.
The next chapter is a discussion of the results after gathering all the data mentioned in this chapter.

Chapter 4 – Discussion of Results

4.1 Introduction

It is time to make a global assessment of the results obtained before and all the study done to this point, reaching this phase of the work. The Catchment Area determination and evaluation will be the main subjects to be discussed, as well as the period, the layout and other pertinent topics.

Catchment Area is evaluated in three distinct periods, through socioeconomic indicators. After discussing the Catchment Area, a layout comparison with other examples in Europe will be shown, to show the similarities and differences with already operational Aerotropolis.

All the topics will be thoroughly explained in order to conclude the viability of an Aerotropolis in the region.

One remark to be made before going into the detailed results is that although this airport is not considered an Aerotropolis, this work purpose is to discover if there is the potential to develop or adapt into one if it is viable and if so, how it can be done.

4.2 Temporal Scenarios

As established in subsection 3.3.1, the years to be analysed in this work are 2001, 2011 and 2016. There are two reasons for this choice.

First, some indicators before 2001 can only be found for NUTS III, except the ones directly related to the CENSUS. For this reason, the data from 2001 and 2011 was quickly gathered, while some of the data from 2016 were gathered directly from the proper channels (PorData and INE), some had to be calculated using other parameters. Nevertheless, this period is what offers the most accurate and real information to create a real solution.

Faro Airport opened in 1966 and had two significant developments: in 1989, a new passenger terminal building was made and its enlargement in 2001 [45]. Even with the improvement in 1989, the airport only became relevant at the beginning of the 2000s, as it is possible to observe in Table 3.2 and Figure 3.5. That data shows the constant rise in movements of the airport since then, therefore becoming an asset to the region and a more reliable subject of study.

4.3 Catchment Area Determination

The creation of a transportation network is the first step towards the determination of the Catchment Area. In Figure 3.2, the transportation network, with a large part of the roads in Algarve and Alentejo

such as highways, principal itineraries and complementary itineraries considered, is shown. The speed limitations are also considered in that figure.

The Faro airport Catchment Area has 60 minutes of travel time reach, as it can be seen in Figure 3.3 and according to previous work [44], it covers most of Algarve, Alentejo, and it even includes Spanish territory, which is not considered to this study.

Some of the counties considered to this study are in both Faro and Lisbon Catchment Area; this means they belong in the competition zone, like Figure 4.1 shows.
This overlap will be furthered discussed, in terms of how these counties have been affected by this through the results of their indicators.

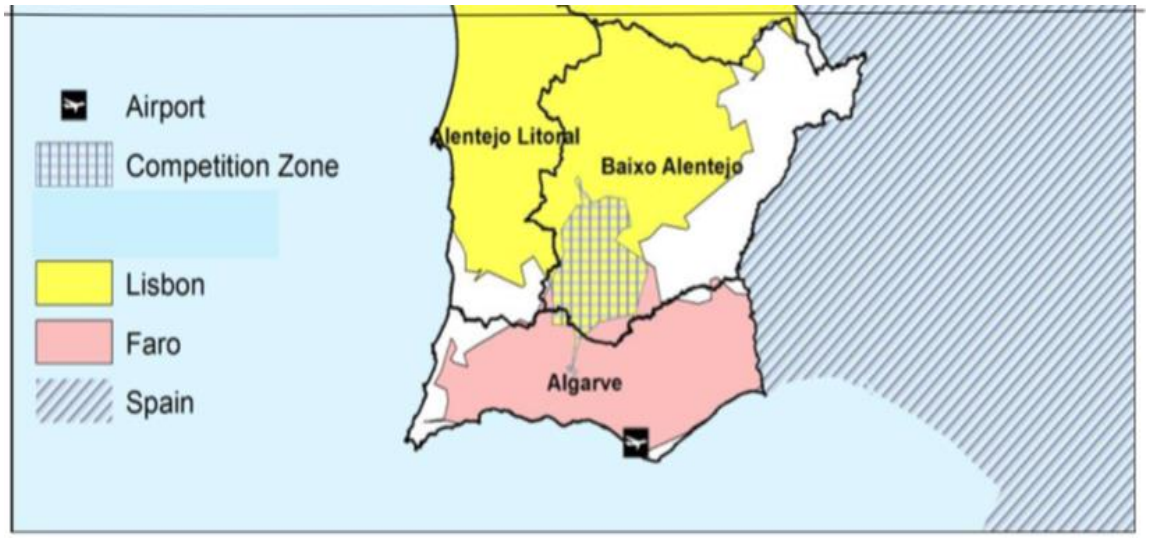

Figure 4.1 – Competition Zone
Source: [44]

4.4 Catchment Area Evaluation

This section contains the results of the Catchment Area evaluation. Considering Table 2.1, the presented socioeconomic indicators, each year of each indicator will be analysed, and the evolution between the three periods. It was used data available from INE and PorData to make this evaluation. Maps and tables with results are presented in Annex, containing the temporal scenarios 2001, 2011, 2016 and the evolution between three timelines: 2001 to 2011, 2001 to 2016 and 2011 to 2016.

4.4.1 Case Study – Faro Airport

I – The Year 2001

Concerning Population Density, Olhão ranks first with considerable margin, being the only to surpass the 300-inhabitants/km² mark. Vila Real de Santo António and Faro rank second and third, respectively,

being very close between them. The bottom three are Alcoutim, Mértola and Ourique, all of which the 10-inhabitants/km² mark is not reached, as seen in Figure 3.4.

In Education Level, Mértola, Alcoutim e Ourique rank last with values slightly over 2%, while on the other hand Faro, Lagos and Portimão gave the highest values, with Faro being the only to reach more than 10% (11%), as presented in figure AI.1.

The counties that have the most household income as seen in Figure AI.2 are Castro Verde, Faro and Loulé. Castro Verde leads with a considerable difference to the second and third county, reaching 973,5€, none other reaches 900€. Mértola, Aljezur and Monchique are the last three in this indicator, all slightly above 555€.

Regarding Economically Active Population, Almodôvar, Mértola and Alcoutim have the lowest percentages, the lowest being Alcoutim with 36,4%. The top three are all above 60%: Albufeira has the highest percentage (66,7%), with Lagoa and Portimão ranking second and third, respectively, as presented in Figure AI.3.

In Figure AI.4 Employment Level, every county is above 85%; the worst is Aljustrel with 87,3%, close to Castro Verde and Mértola. The highest are all close to 95%: Castro Marim, Loulé and Silves.

Figure AI.5 shows Companies Density has a significant disparity between the top and bottom. With less than one company per square kilometre, Alcoutim, Mértola and Ourique are the bottom three, while Olhão, Faro e Albufeira with 39,74, 38,37 and 37,08 respectively are the top three.

Alcoutim, Aljezur and Castro Marim show the lowest numbers of Sectorial Structure of Employment, Alcoutim only 143, while on the other end Faro and Loulé reaching 14000 and Albufeira 11687, as seen in Figure AI.6.

In Figure AI.7, the Business Volume in Faro, Albufeira and Portimão are the top three. Faro leads with 4 million/km², Mértola and Alcoutim are the lowest with less than 140 thousand/km² and Almodôvar almost reaching 190 thousand/km².

Unsurprisingly, Faro and Portimão have the best values in the Health indicator: Faro with 1,98 doctors/km² and Portimão 0,95 doctors/km², the top three is completed with Lagoa (0,49 doctors/km²). Values close to 0,008 doctors/km² put Alcoutim, Mértola and Ourique in the bottom three, as presented in Figure AI.8.

Figure AI.9, the Tourist Attraction indicator, Almodôvar, Mértola and Ourique fail to reach 0,002 attractions/km² to compose the bottom three. The top three is made up by Lagoa (0,2247

attractions/km²), Albufeira (0,1631 attractions/km²) and Vila Real de Santo António (0,0806 attractions/km²).

In 2001, Aljustrel, Mértola and Alcoutim had no Hotel Establishments. Albufeira has the most Hotel Establishments, 125, much more than the second and third counties: Loulé had 59 and Portimão 55, as shown by Figure AI.10.

In Figure AI.11, because of the previous indicator, Aljustrel, Mértola and Alcoutim had an Accommodation Capacity of zero. The top three also match the same as Hotel Establishments. Albufeira leads with 35552.

Figure AI.12 presents Occupation Rate where Aljustrel, Mértola and Alcoutim, obviously rank last with 0%, but Silves and Castro Marim have the highest Occupation Rate, over 54%.

All these indicators can be seen in Table 4.1, with the top three counties highlighted in green and the bottom three in red, in each indicator. In the year 2001, it is possible to see that Mértola ranked bottom three in all but one indicator and did not make the top three in any indicator. Alcoutim ranked bottom three in 10 of the 13 indicators. Faro and Albufeira ranked top three in 7 of the 13 indicators. In the year 2001, one can say that Faro and Albufeira benefitted from their relatively close location to the airport, while Mértola and Alcoutim, being close to the end of the Catchment Area of Faro airport felt the least advantages of being within the Catchment Area.

Table 4.1 – 2001 Socioeconomic Indicators.

Source: Own elaboration.

Counties	Population Density	Education Level	Household Income	Economically Active Population	Employment Level	Companies Density	Sectorial Structure of Employment	Business Volume	Health	Tourist Attractions	Hotel Establishemnts	Accommodation Capacity	Occupation Rate
	Inhabitants / km²	%	€	%	%	Companies / km²	Nº	€ / km²	Doctors / km²	Attractions / km²	Nº	Nº	%
Aljustrel	23,1	3,4	664,4	45,3	87,3	2,39	1025	80441,05	0,0153	0,0022	0	0	0
Almodôvar	10,5	2,9	611,3	44,6	92,5	1,31	566	18921,49	0,009	0,0013	1	20	17,2
Castro Verde	13,4	4,1	973,5	51,5	88,4	1,15	1780	249861,16	0,0088	0,0018	1	76	17,2
Mértola	6,7	2,2	555,0	40,5	87,7	0,65	519	13592,42	0,0039	0,0015	0	0	0
Ourique	9,3	2,3	626,6	46,1	89,5	0,99	614	29457,14	0,0075	0,0015	1	10	0
Albufeira	224,2	6,4	692,3	66,7	93,8	37,08	11687	3505539,01	0,2766	0,1631	125	35552	45,5
Alcoutim	6,5	2,1	630,1	36,4	92,7	0,53	143	13906,41	0,0069	0,0035	0	0	0
Aljezur	16,4	3,9	555,1	44,9	93,9	2,19	422	66702,79	0,0217	0,0372	1	52	23,4
Castro Marim	22,0	3,1	583,2	45,7	94,9	2,56	437	58170	0,0267	0,0133	3	487	54
Faro	287,2	11,0	828,8	60	94,4	38,37	14318	4732485,149	1,9802	0,0495	19	1334	44,5
Lagoa	232,3	5,8	700,0	61,9	93,5	33,64	4011	2911191,011	0,4944	0,2247	29	6938	49,3
Lagos	119,2	7,5	642,0	58,2	94,5	17,39	4631	918272,3005	0,23	0,061	32	3818	43,8
Loulé	77,3	5,9	728,0	57,4	94,9	12,18	14298	1081596,078	0,1229	0,0222	59	12434	43
Monchique	17,6	2,9	559,4	45,9	94,6	2,25	630	56290,4	0,0101	0,0025	5	125	9,9
Olhão	313,9	4,9	684,8	55,1	92,4	39,74	3955	1982538,462	0,3308	0,0385	3	47	12,7
Portimão	246,9	7,5	687,4	60,3	92,6	34,48	10427	3255428,571	0,9505	0,0714	55	16304	41,3
São Brás de Alportel	66,8	6,8	623,8	53	93,8	7,95	1002	508460	0,12	0,0133	1	66	50,2
Silves	49,8	4,3	667,2	53,7	94,6	6,4	4308	468567,0103	0,0309	0,0074	9	1390	54,7
Tavira	41,1	5,6	631,8	49,9	93,6	5,44	2659	158338,26	0,0608	0,0099	14	3218	34,6
Vila Real de Santo António	290,1	4,7	630,3	55,4	91,6	40,27	2875	2237951,613	0,3065	0,0806	16	3858	46,6

II-The Year 2011

In 2011, Olhão had the highest Population Density (346,9 inhabitants/km²), followed by Faro (319,9 inhabitants/km²) and Vila Real de Santo António (312,8 inhabitants/km²). Alcoutim, Mértola and Ourique rank bottom three with 5,1, 5,6 and 8,1 inhabitants/km², respectively, as presented in Figure 3.5.

In Figure AII.1 Education Level shows that Faro reaches 19,8%, the highest value, Portimão and São Brás de Alportel come next with 13,6% and 12,4%. Alcoutim, Mértola and Ourique with close to 5% are the bottom three.

Concerning Household Income, Castro Verde leads by far with 1578,1€, Faro follows with just over 1000€ and Aljustrel slightly under 1000€. In Ourique, Alcoutim and Almodôvar, none surpass the 761€ mark, as seen in Figure AII.2.

Figure AII.3 present the highest percentages of Economically Active Population belong to Albufeira (65,7%), Faro (59,7%) and Portimão (59,2%). On the other end of the spectrum are Alcoutim (35,2%), Mértola (41,5%) and Aljezur (43,9%).

In Figure AII.4 regarding Employment Level, the lowest numbers go to Vila Real de Santo António (80,1%), Olhão (82,7%) and Portimão (82,8%). Faro is the only over 90%, followed by Castro Verde (89,7%) and Mértola (88%).

On Companies Density, three counties have less than 1,0 companies/km²: Mértola, Ourique and Alcoutim. Albufeira and Faro have over 40 companies/km² and are the top 2 counties in this indicator, shown in Figure AII.5.

In Figure AII.6, Alcoutim is the only county with less than 1000 workers in the Sectorial Structure of Employment, followed by Ourique and Almodôvar with slightly less than 1500. Loulé leads this indicator with 29688 workers, considerable difference to Faro (21220) and Portimão (18302).

Considering Business Volume, Faro is the only county over 6 million €/km², Albufeira is second with 5.7 million/km², Portimão is third with 5 million €/km². Alcoutim failed to reach the 25 thousand €/km² mark, being the lowest in volume, presented in Figure AII.7.

In Figure AII.8, there are three counties very close to zero in Health indicator: Almodôvar, Castro Verde and Mértola. Faro has over two doctors/km²; Portimão has 1,5 and Lagoa 0,764.

Looking at Tourist Attractions, Lagoa, Faro and Albufeira have the most attractions/km², all close to 0,2 attractions/km². Mértola, Ourique and Monchique rank last with values between 0,0045 and 0,0076 attractions/km², as seen in Figure AII.9.

Figure AII.10 shows that in the year 2011, São Brás de Alportel and Ourique had zero establishments, therefore having zero Accommodation Capacity and Occupation Rate. Albufeira had 145 establishments, leading by far Loulé's 63 and Portimão's 48.

Alcoutim had only one establishment with an Accommodation Capacity of 42, making it the lowest outside of Ourique and São Brás de Alportel. The counties that present the most significant capacity are Albufeira (45474) followed by Loulé (13453) and Portimão (11717), presented in Figure AII.11.

As for Occupation Rate, Olhão has the highest percentage (47,8%), seconded by Vila Real de Santo António (46,8%). Alcoutim only accounts for 12% of Occupation Rate, shown in Figure AII.12.

The data from this year is presented in Table 4.2, highlighting the top three and bottom three in each indicator. This part of the study shows that Alcoutim ranks bottom three in 10 of 13 indicators and top three in one of them, while Ourique ranks bottom three in 9 of the 13 indicators and none in top three. Ourique belongs to a Competition Zone between Faro and Lisbon, therefore is located at the end of both Catchment Areas, while Alcoutim is within only one Catchment Area, but also at the end of it.
Faro and Portimão, however, rank top three in 9 of the 13 indicators. Faro is closer to the airport, and that is why it ranks so high, while Portimão is easily accessible by highway, shows good values for Health, Companies Density and Accommodation Capacity, making it one of the counties affected positively by the development of the airport.

Table 4.2 – 2011 Socioeconomic Indicators.

Source: Own elaboration.

Counties	Population Density	Education Level	Household Income	Economically Active Population	Employment Level	Companies Density	Sectorial Structure of Employment	Business Volume	Health	Tourist Attractions	Hotel Establishemnts	Accommodation Capacity	Occupation Rate
	Inhabitants / km²	%	€	%	%	Companies / km²	Nº	€ / km²	Doctors / km²	Attractions / km²	Nº	Nº	%
Aljustrel	20,2	8,0	991,1	48,6	85,6	1,9	1 989	309 607,0	0,024	0,0153	2	73	30,9
Almodôvar	9,6	5,9	761,0	46,6	87,2	1,0	1 318	65 433,7	0,003	0,0103	2	44	25,0
Castro Verde	12,8	9,9	1 578,1	52	89,7	1,2	2 229	854 592,3	0,007	0,0176	2	122	31,3
Mértola	5,6	5,1	761,4	41,5	88	0,6	1 404	41 819,8	0,002	0,0054	1	62	17,2
Ourique	8,1	5,5	740,1	45,7	87,4	0,9	1 138	89 780,5	0,009	0,0045	0	0	0,0
Albufeira	290,3	11,5	913,9	65,7	82,8	43,7	17 447	5 704 241,1	0,56	0,2128	145	45474	46,3
Alcoutim	5,1	4,5	755,2	35,2	91,2	0,5	475	24 109,2	0,01	0,0173	1	42	12,0
Aljezur	18,2	9,3	814,2	43,9	88	2,4	1 342	176 362,2	0,019	0,0464	4	180	13,0
Castro Marim	22,4	7,6	826,3	49	82,9	2,3	1 509	191 126,7	0,033	0,02	3	549	25,0
Faro	319,8	19,8	1 067,3	59,7	86,8	43,4	21 220	6 323 910,9	2,629	0,1733	22	2329	34,7
Lagoa	260,3	10,0	939,7	58,7	82,9	34,1	8 014	4 001 000,0	0,764	0,2697	34	8064	36,7
Lagos	145,8	12,3	887,4	57,4	84,3	19,6	9 716	2 008 924,9	0,376	0,1174	33	5662	34,0
Loulé	92,4	11,1	963,1	58,4	84,9	13,2	29 688	1 981 047,1	0,179	0,0314	63	13453	39,4
Monchique	15,3	6,7	775,4	44,8	85,3	1,8	1 322	119 252,5	0,008	0,0076	6	393	36,7
Olhão	346,9	10,4	905,0	57,3	82,7	37,1	9 941	3 397 900,0	0,623	0,0538	6	760	47,8
Portimão	305,5	13,6	934,8	59,2	82,8	39,8	18 302	5 094 642,9	1,538	0,1429	48	11717	44,6
São Brás de Alportel	69,5	12,4	930,6	55,2	87,8	8,3	2 619	750 866,7	0,207	0,0133	0	0	0,0
Silves	54,6	8,7	904,0	54,6	84,4	6,0	8 374	601 070,7	0,056	0,0471	6	1742	34,7
Tavira	43,1	11,1	834,9	52,6	84,9	5,1	6 373	396 019,7	0,089	0,0328	14	4724	37,4
Vila Real de Santo António	312,8	8,9	839,5	55,3	80,1	36,7	5 418	3 583 467,7	0,532	0,129	18	6021	46,8

III-The Year 2016

Figure 3.6 shows that Population Density has the highest values in Olhão with 345,5 inhabitants/km^2, Vila Real de Santo António (311 inhabitants/km^2) and Albufeira (287,9 inhabitants/km^2). The lowest values belong to Alcoutim (4,2 inhabitants/km^2), Mértola (5,0 inhabitants/km^2) and Ourique (7,3 inhabitants/km^2).

In Figure AIII.1 concerning Education Level, only Faro has over 10%, reaching 12,5%, while Castro Verde e Albufeira with 8,3% and 8,4% are very close to each other. On the other hand, Almodôvar, Mértola and Ourique only reach values slightly above 3%.

Regarding Household Income, Castro Verde leads with a large margin, with 1671,8€. Aljustrel and Faro slightly surpass de 1050€ for second and third places. Mértola, Ourique and Castro Marim are all in the bottom three with values between 775,4€ and 785,9€, as presented in Figure AIII.2.

On the Economically Active Population, Almodôvar, Alcoutim and Aljezur go beyond the 30% mark, to rank bottom three, while Albufeira has 70,3%, Loulé with 55,2% and Faro with 52,4% close the top three, as seen in Figure AIII.3.

In Figure AIII.4 three counties surpass the 90% on Employment Level, they are Castro Verde (92,2%), Loulé (91,4%) and Albufeira (90,9%). Mértola has the worst percentage, with 74,3%, close Almodôvar (76,4%).

Albufeira is the only county with over 50 companies/km^2; Faro and Lagoa close the top three. Meanwhile, Mértola and Alcoutim fail to reach 1,0 companies/km^2 in this Companies Density indicator, as shown in Figure AIII.5.

As for Sectorial Structure of Employment, Loulé has the most significant number of employers, 18562, Albufeira with 15123 and Faro 14693 are the second and third. On the low side of the spectrum, Alcoutim only has 304, Monchique 616 and Aljezur 640, as presented in Figure AIII.6.

Figure AIII.7 depicts the Business Volume indicator and shows how Faro and Albufeira are fairly close, with 6.96 million€/km^2 and 6.73 million€/km^2, respectively. Alcoutim has the lowest Business Volume, accounting only 21762€/km^2, Mértola 41781€/km^2.

The Health indicator has a clear disparity: Faro and Portimão lead with 2,97 doctors/km^2 and 1,85 doctors/km^2, respectively, while Castro Verde, Mértola and Ourique are very close to zero, as seen in Figure AIII.8.

In Figure AIII.9, the county with most Tourist Attractions per square kilometre is Lagoa, marking 0,24 attractions/km^2. Mértola, Ourique and São Brás de Alportel are the bottom three with values close to 0,007 attractions/km^2.

In Figure AIII.10, Hotel Establishments shows how Albufeira has the most number of establishments, 180, Loulé is second by far with 89 and Lagos has 67. Alcoutim, Ourique and São Brás de Alportel only have 2,3 and 4, respectively.

Albufeira has the most significant Accommodation Capacity, 48727; Loulé and Portimão only surpass the 16 thousand mark by little. São Brás de Alportel shows the lowest number, only 20, half of Alcoutim, the second lowest, as presented in Figure AIII.11.

In Figure AIII.12 for Occupation Rate, Albufeira also leads with 54,5%, close Olhão (52,9%) and Vila Real de Santo António (51,7%). With values slightly over 20%, Aljustrel, São Brás de Alportel and Almodôvar are the bottom three.

Table 4.3 shows the detailed values of the Year 2016. Ourique had the lowest numbers in 9 of the 13 indicators, while Albufeira ranked top three in 11 of the 13 indicators. Albufeira took advantage of the rise of the movement in the airport in the latest years to reach these values.

Table 4.3 – 2016 Socioeconomic Indicators

Source: Own elaboration.

Counties	Population Density	Education Level	Household Income	Economically Active Population	Employment Level	Companies Density	Sectorial Structure of Employment	Business Volume	Health	Tourist Attractions	Hotel Establishemnts	Accommodation Capacity	Occupation Rate
	Inhabitants / km²	%	€	%	%	Companies / km²	Nº	€ / km²	Doctors / km²	Attractions / km²	Nº	Nº	%
Aljustrel	18,6	5,2	1073,9	43,2	86,5	2,0	1 714,0	542 224,9	0,0284	0,0087	6,0	204,0	20,2
Almodôvar	8,9	3,1	850,2	32,6	76,4	1,1	793,0	78 586,9	0,0129	0,009	6,0	84,0	23,0
Castro Verde	12,5	8,3	1671,8	59,3	92,2	1,3	2 665,0	553 149,4	0,0053	0,0123	6,0	160,0	25,2
Mértola	5,0	3,2	775,4	35,8	74,3	0,6	770,0	41 781,1	0,0046	0,0039	13,0	260,0	31,7
Ourique	7,3	3,3	781	38,5	79,5	1,0	749,0	108 568,4	0,009	0,0045	3,0	84,0	26,7
Albufeira	287,9	8,4	911,4	70,3	90,9	52,7	15 123,0	6 726 794,3	0,6099	0,1702	180,0	48 727,0	54,5
Alcoutim	4,2	5,6	829,7	32,3	85,0	0,5	304,0	21 762,6	0,0139	0,0139	2,0	40,0	24,0
Aljezur	17,3	4,6	798,3	33,1	85,0	2,9	640,0	210 396,3	0,0341	0,0402	22,0	518,0	28,3
Castro Marim	21,4	4,4	785,9	37,3	81,8	2,3	797,0	174 103,3	0,0433	0,02	13,0	1 199,0	41,2
Faro	301,4	12,5	1089,8	52,4	90,3	45,4	14 693,0	6 963 445,5	2,9703	0,203	29,0	2 395,0	50,9
Lagoa	258,3	6,7	924,3	50,1	87,7	43,9	5 433,0	5 019 449,4	0,8427	0,2472	38,0	10 850,0	47,2
Lagos	144,4	6,1	891,2	45,0	87,9	23,5	6 119,0	2 452 582,2	0,446	0,1127	67,0	8 292,0	43,3
Loulé	90,9	7,8	969,2	55,2	91,4	15,7	18 562,0	2 263 380,4	0,2196	0,0275	89,0	16 330,0	47,4
Monchique	13,7	4,9	808,6	36,0	80,1	1,9	616,0	169 502,5	0,0152	0,0076	11,0	682,0	26,7
Olhão	345,4	4,5	870,8	33,6	82,5	39,3	4 904,0	3 723 800,0	0,7308	0,0769	9,0	772,0	52,9
Portimão	304,5	8,1	953,9	49,0	85,5	40,7	11 559,0	5 423 989,0	1,8462	0,1319	63,0	16 200,0	50,4
São Brás de Alportel	68,8	4,9	846,7	34,0	87,2	10,1	1 188,0	834 786,7	0,2467	0,0067	4,0	20,0	21,0
Silves	53,7	4,1	877,7	33,9	83,2	6,9	4 490,0	601 870,4	0,0663	0,053	16,0	3 025,0	38,2
Tavira	41,7	5,9	843,4	41,7	88,9	6,5	3 976,0	472 128,1	0,11	0,0427	28,0	4 798,0	43,3
Vila Real de Santo António	311,2	4,1	855,7	43,4	81,7	36,5	3 313,0	4 451 145,2	0,6452	0,1452	28,0	6 593,0	51,7

IV- Evolution 2001-2011

From 2001 to 2011, three counties grew higher than the rest in Population Density: Albufeira registered a 66,1 inhabitants/km^2 jump, followed by Portimão with 58,6 and Olhão 33,0 inhabitants/km^2. Several counties saw their values decrease, the most important ones are Aljustrel with -2,9 inhabitants/km^2, Monchique -2,3, and Ourique with -1,2, as seen in Figure AIV.1.

Figure AIV.2 shows Education Level grew in every county, Faro had the biggest rise, up to 8,8%. Portimão and Castro Verde were close with 6,1 and 5,8, respectively. Alcoutim, Mértola and Almodôvar show the lowest levels of growth with 2,4, 2,9 and 3,0, respectively.

In Figure AIV.3, the Household Income had a massive rise in Castro Verde, with a gap of 604,6€ between 2001 and 2011. Also, significant rises, but not that massive was Aljustrel with 326,7€ and São Brás de Alportel with 306,8€. Only three counties saw their numbers grow less than 150€: Ourique, Alcoutim and Almodôvar.

The Economically Active Population did not change much, with all counties marking between -3,2% and 3,3%. On top Aljustrel and Castro Marim, both with 3,3% and on bottom Lagoa with -3,2% and Alcoutim -1,1%, as seen in Figure AIV.4.

Figure AIV.5, concerning Employment Level, only Castro Verde and Mértola saw improvement, 1,3 and 0,3%, respectively. Castro Marim, Vila Real de Santo António and Albufeira all saw a decrease between 11% and 12%.

Albufeira, Faro and Portimão are the only counties to reach over 5,0 companies/km^2 in the Companies Density indicator, Albufeira reaching a 6,6 companies/km^2 growth. Vila Real de Santo António saw a decrease of 3,6 companies/km^2, Olhão 2,6 and Monchique 0,5, as presented in Figure AIV.6.

In Figure AIV.7, Loulé had the biggest rise in Sectorial Structure of Employment by far, with 15390 workers; Portimão with 7875 and Faro 6902 are second and third. Alcoutim has the lowest number, while positive, with 332. Castro Verde with 449 and Ourique with 524 complete the bottom three.

Business Volume is one of the indicators that saw growth in every county, topped by Albufeira with 2.2 million €/km^2, Portimão reached 1.8 million €/km^2, and Faro surpassed the 1.5 million €/km^2 mark. Alcoutim only had a 10 thousand €/km^2 growth, Mértola 28 thousand €/km^2 and Almodôvar 46 thousand €/km^2, presented in Figure AIV.8.

Figure AIV.9 shows that the Health indicator had no considerable differences; the bigger differences were Faro with a rise of 0,6488 doctors/km^2 and Portimão 0,5875 doctors/km^2.

In Tourist Attractions, no county scored below zero; however, São Brás de Alportel had 0. On the other hand, Faro was the only surpassing a 0,1 attractions/km^2 improvement, shown in Figure AIV.10.

In Figure AIV.11, regarding Hotel Establishments, Portimão had a reduction of 7 hotel establishments, Silves 3, while Albufeira had 20 more, Lagoa 5 and Loulé 4.

Figure AIV.12 shows that Albufeira saw a higher rise in Accommodation Capacity, reaching 9922, much more than Vila Real de Santo António with 2163 and Lagos 1844. Portimão had a -4587 differential, considerably more than São Brás de Alportel (-66) and Ourique (-10).

In Figure AIV.13, Olhão and Aljustrel saw an increase of over 30% in Occupation Rate, while São Brás de Alportel reached a 50,2% decrease, Castro Marim -29% and Silves -20%.

Detailed Table 4.4 contains the results for every indicator. The evolution between 2001 and 2011 happened somewhat evenly. Ourique ranked bottom three in 6 indicators, which is less than half, while Portimão ranked top three in 7. Thus, this occurred due to the development of the accessibility to each county and the growth of the airport in these years.

Table 4.4 – Evolution of the Socioeconomic Indicators from 2001 to 2011

Source: Own elaboration.

Counties	Population Density	Education Level	Household Income	Economically Active Population	Employment Level	Companies Density	Sectorial Structure of Employment	Business Volume	Health	Tourist Attractions	Hotel Establishemnts	Accommodation Capacity	Occupation Rate
	Inhabitants / km²	%	€	%	%	Companies / km²	Nº	€ / km²	Doctors / km²	Attractions / km²	Nº	Nº	%
Aljustrel	-2,9	4,6	326,7	3,3	-1,7	-0,5	964,0	229 165,9	0,0087	0,0131	2,0	73,0	30,9
Almodôvar	-0,9	3,0	149,7	2,0	-5,3	-0,3	752,0	46 512,2	-0,006	0,009	1,0	24,0	7,8
Castro Verde	-0,6	5,8	604,6	0,5	1,3	0,1	449,0	604 731,1	-0,0018	0,0158	1,0	46,0	14,1
Mértola	-1,1	2,9	206,4	1,0	0,3	-0,1	885,0	28 227,4	-0,0019	0,0039	1,0	62,0	17,2
Ourique	-1,2	3,2	113,5	-0,4	-2,1	-0,1	524,0	60 323,3	0,0015	0,003	-1,0	-10,0	0,0
Albufeira	66,1	5,1	221,6	-1,0	-11,0	6,6	5 760,0	2 198 702,1	0,2834	0,0497	20,0	9 922,0	0,8
Alcoutim	-1,4	2,4	125,1	-1,2	-1,5	-0,0	332,0	10 202,8	0,0031	0,0138	1,0	42,0	12,0
Aljezur	1,8	5,4	259,1	-1,0	-5,9	0,2	920,0	109 659,4	-0,0027	0,0092	3,0	128,0	-10,4
Castro Marim	0,4	4,5	243,1	3,3	-12,0	-0,3	1 072,0	132 956,7	0,0063	0,0067	0,0	62,0	-29,0
Faro	32,6	8,8	238,5	-0,3	-7,6	5,0	6 902,0	1 591 425,7	0,6488	0,1238	3,0	995,0	-9,8
Lagoa	28,0	4,2	239,7	-3,2	-10,6	0,5	4 003,0	1 089 809,0	0,2696	0,045	5,0	1 126,0	-12,6
Lagos	26,6	4,8	245,4	-0,8	-10,2	2,2	5 085,0	1 090 652,6	0,146	0,0564	1,0	1 844,0	-9,8
Loulé	15,1	5,2	235,1	1,0	-10,0	1,0	15 390,0	899 451,0	0,0561	0,0092	4,0	1 019,0	-3,6
Monchique	-2,3	3,8	216,0	-1,1	-9,3	-0,5	692,0	62 962,1	-0,0021	0,0051	1,0	268,0	26,8
Olhão	33,0	5,5	220,2	2,2	-9,7	-2,6	5 986,0	1 415 361,5	0,2922	0,0153	3,0	713,0	35,1
Portimão	58,6	6,1	247,4	-1,1	-9,8	5,3	7 875,0	1 839 214,3	0,5875	0,0715	-7,0	-4 587,0	3,3
São Brás de Alportel	2,7	5,6	306,8	2,2	-6,0	0,4	1 617,0	242 406,7	0,087	0	-1,0	-66,0	-50,2
Silves	4,8	4,4	236,8	0,9	-10,2	-0,4	4 066,0	132 503,7	0,0251	0,0397	-3,0	352,0	-20,0
Tavira	2,0	5,5	203,1	2,7	-8,7	-0,3	3 714,0	237 681,4	0,0282	0,0229	0,0	1 506,0	2,8
Vila Real de Santo António	22,7	4,2	209,2	-0,1	-11,5	-3,6	2 543,0	1 345 516,1	0,2255	0,0484	2,0	2 163,0	0,2

V- Evolution 2001-2016

In these 15 years, the Population Density increased in most counties, with the most relevant being Albufeira with a boost of 63,7 inhabitants/km^2 and Portimão 57,6 inhabitants/km^2. Aljustrel and Monchique had the biggest drops with -4,5 inhabitants/km^2 and -3,9 inhabitants/km^2, presented in Figure AV.1.

In Figure AV.2 the Education Level kept steady in almost every county: the most significant variations were Castro Verde and Alcoutim with a 4,2% and 3,5% raise, respectively, while São Brás de Alportel and Lagos decreased by 1,9% and 1,4%, respectively too.

In Figure AV.3, Castro Verde registered, by far, the highest rise in Household Income, 698,3€, followed by Aljustrel (409,5€) and Portimão (266,5€). Although no county registered a negative differential, Ourique with 154,4€ has the smallest difference. Olhão and Alcoutim also failed to reach the 200€ mark.

Figure AV.4 shows that only two counties saw their Economically Active Population numbers grow. Castro Verde with 7,8% and Albufeira with 3,6%, respectively, while Olhão, Silves and São Brás de Alportel reached over 19% decrease in this indicator.

In Figure AV.5, the Employment Level did not improve overall in this period, as Castro Verde with a 3,8% increase was the only to score a positive differential. Almodôvar reached -16,5%, followed by Monchique (14,5%) and Mértola (13,4%) to complete the bottom three.

Regarding Companies Density, Albufeira topped the chart with a 15,6 companies/km^2 boost, Lagoa reached 10,3 companies/km^2 and Faro 7,0 companies/km^2 to complete the top three. Vila Real de Santo António saw a decline of 3.8 companies/km^2. Monchique, Aljustrel, Almodôvar, Mértola, Alcoutim, Castro Marim and Olhão all registered between -0,5 and 0 companies/km^2, as presented in Figure AV.6.

In Figure AV.7, the number of workers on Sectorial Structure of Employment went up on every county, except one, Monchique, that had a -14 score. Loulé had over 4000 more workers and Albufeira over 3000.

In Figure AV.8, every county raised their Business Volume: Alcoutim surpassed the 7 thousand €/km^2, Mértola close to 30 thousand €/km^2 and Almodôvar slightly under the 60 thousand mark. Albufeira recorded over 3 million €/km^2 raise, while Faro and Vila Real de Santo António kept close to each other, with 2.23 million €/km^2 and 2.21 million €/km^2, respectively.

The Health indicator maintained approximately the same values. The only mentionable numbers are the rise of 0,99 doctors/km^2 in Faro and 0,89 doctors/km^2 in Portimão, as seen in Figure AV.9.

In Tourist Attractions, Faro with a 0,1535 attractions/km^2 increase registered the only notable mention. São Brás de Alportel was the only county to register a negative differential with -0,0066 attractions/km^2, as presented in Figure AV.10.

In Hotel Establishments, Albufeira tops every other county with 55 more establishments, Lagos with 35 and Loulé 30, close the top three. While no county saw a decrease in Hotel Establishments, Ourique and Alcoutim rank last with only two more establishments, as shown in Figure AV.11.

In Figure AV.12, Albufeira stands out in Accommodation Capacity, with over 13 thousand more beds. Lagos and Loulé recorded an increase of 4474 and 3896, respectively. Portimão improved in the previous indicator, but the number of beds went down by 104, the biggest drop, followed by São Brás de Alportel with -46.

As for Occupation Rate, Olhão registered a 40,2% rise, followed by Mértola (31,7%) and Ourique (26,7%). São Brás de Alportel had the lowest difference, -29,2%; Silves (-16.5%) and Castro Marim (-12.8%) seal the bottom three, as seen in Figure AV.13.

Detailed Table 4.5, presents the results for every indicator and county. This period of fifteen years shows a clear evolution of one county, Albufeira. It ranked top three in 9 indicators, and it is a visible indication that Albufeira followed the airport's improvement in this period, taking advantage of the easy accessibility. On the other hand, São Brás de Alportel ranked bottom three in 6 of the 13 indicators and zeroed in the top three. Being a small county and not very reachable, the ageing population contributed to the low scores in this period.

Table 4.5 – Evolution of the Socioecoomic Indicators from 2001 to 2016.

Source: Own elaboration.

Counties	Population Density	Education Level	Household Income	Economically Active Population	Employment Level	Companies Density	Sectorial Structure of Employment	Business Volume	Health	Tourist Attractions	Hotel Establishemnts	Accommodation Capacity	Occupation Rate
	Inhabitants / km²	%	€	%	%	Companies / km²	Nº	€ / km²	Doctors / km²	Attractions / km²	Nº	Nº	%
Aljustrel	-4,5	1,8	409,5	-2,1	-0,8	-0,4	689,0	461 783,8	0,0131	0,0065	6,0	204,0	20,2
Almodôvar	-1,6	0,2	238,9	-12,0	-16,1	-0,2	227,0	59 665,4	0,0039	0,0077	5,0	64,0	5,8
Castro Verde	-0,9	4,2	698,3	7,8	3,8	0,2	885,0	303 288,2	-0,0035	0,0105	5,0	84,0	8,0
Mértola	-1,7	1,0	220,4	-4,7	-13,4	-0,1	251,0	28 188,7	0,0007	0,0024	13,0	260,0	31,7
Ourique	-2,0	1,0	154,4	-7,6	-10,0	0,0	135,0	79 111,3	0,0015	0,003	2,0	74,0	26,7
Albufeira	63,7	2,0	219,1	3,6	-2,9	15,6	3 436,0	3 221 255,3	0,3333	0,0071	55,0	13 175,0	9,0
Alcoutim	-2,3	3,5	199,6	-4,1	-7,7	-0,0	161,0	7 856,2	0,007	0,0104	2,0	40,0	24,0
Aljezur	0,9	0,7	243,2	-11,8	-8,9	0,7	218,0	143 693,5	0,0124	0,003	21,0	466,0	4,9
Castro Marim	-0,6	1,3	202,7	-8,4	-13,1	-0,3	360,0	115 933,3	0,0166	0,0067	10,0	712,0	-12,8
Faro	14,2	1,5	261,0	-7,6	-4,1	7,0	375,0	2 230 960,4	0,9901	0,1535	10,0	1 061,0	6,4
Lagoa	26,0	0,9	224,3	-11,8	-5,8	10,3	1 422,0	2 108 258,4	0,3483	0,0225	9,0	3 912,0	-2,1
Lagos	25,2	-1,4	249,2	-13,2	-6,6	6,1	1 488,0	1 534 309,9	0,216	0,0517	35,0	4 474,0	-0,5
Loulé	13,6	1,9	241,2	-2,2	-3,5	3,5	4 264,0	1 181 784,3	0,0967	0,0053	30,0	3 896,0	4,4
Monchique	-3,9	2,0	249,2	-9,9	-14,5	-0,4	-14,0	113 212,1	0,0051	0,0051	6,0	557,0	16,8
Olhão	31,5	-0,4	186,0	-21,5	-9,9	-0,4	949,0	1 741 261,5	0,4	0,0384	6,0	725,0	40,2
Portimão	57,6	0,6	266,5	-11,3	-7,1	6,2	1 132,0	2 168 560,4	0,8957	0,0605	8,0	-104,0	9,1
São Brás de Alportel	2,0	-1,9	222,9	-19,0	-6,6	2,2	186,0	326 326,7	0,1267	-0,0066	3,0	-46,0	-29,2
Silves	3,9	-0,2	210,5	-19,8	-11,4	0,5	182,0	133 303,4	0,0354	0,0456	7,0	1 635,0	-16,5
Tavira	0,6	0,3	211,6	-8,2	-4,7	1,1	1 317,0	313 789,8	0,0492	0,0328	14,0	1 580,0	8,7
Vila Real de Santo António	21,1	-0,6	225,4	-12,0	-9,9	-3,8	438,0	2 213 193,5	0,3387	0,0646	12,0	2 735,0	5,1

VI- Evolution 2011-2016

In Figure AVI.1, Population Density dropped in every county: Faro hitting the lowest with -18,4 inhabitants/km^2, very far of the next two, Albufeira and Lagoa with -2,4 inhabitants/km^2 and 2,0 inhabitants/km^2, respectively. The least affected counties were Castro Verde with -0,3 inhabitants/km^2, Mértola -0,6 inhabitants/km^2, and Almodôvar -0,7 inhabitants/km^2.

In Figure AVI.2, Alcoutim registered the only improvement in Education Level with 1,1% difference, while São Brás de Alportel and Faro went down over 7,0%.

The Household Income went up by a maximum of 93,7€ in Castro Verde, followed by Almodôvar and Aljustrel with 89,2€ and 82,8€. São Brás registered a low -83,9€ difference, Castro Marim had -40,4€ and Olhão -34,2€ to close the bottom three, as seen in Figure AVI.3.

Figure AVI.4 concerning Economically Active Population. Only two counties improved in these five years, Castro Verde with a 7,3% and Albufeira with a 4,6% increases. Olhão, São Brás de Alportel and Silves decreased over 20%.

On Employment Level, Albufeira leads with an 8,1% rise, followed by Loulé 6,5% and Lagoa 4,8%. Mértola presents the lowest numbers with -13,7%, followed by Almodôvar -10,8% and Ourique -7,9%, as presented in Figure AVI.5.

In Figure AVI.6, Vila Real de Santo António with -0,2 companies/km^2 is the only one to have a negative differential in Companies Density. Lagoa grew 9,8 companies/km^2, close to Albufeira with 9,0 companies/km^2.

In the Sectorial Structure of Employment indicator, only Castro Verde augmented the number of workers by 436. Mértola ranked bottom with -634 workers, followed by Almodôvar (-525) and Ourique (-389), as seen in Figure AVI.7.

In Figure AVI.8, the 1 million €/km^2 difference mark was only surpassed by Albufeira and Lagoa in the Business Volume.
Most counties recorded positive differences, while the negatives were not very considerable, except for Castro Verde with a -301 thousand €/km^2.

The Health indicator has not changed much in this period; the notable differences are Faro and Portimão with 0,34 doctors/km^2 and 0,30 doctors/km^2 rises, respectively, as presented in Figure AVI.9.

The Tourist Attractions indicator is the one that revealed the fewer differences within this time frame, with all counties ranging from -0,04 to 0,03, all close to zero, as shown in Figure AVI.10.

In Figure AVI.11, every county had more Hotel Establishments by 2016: Albufeira registered 35 more, reasonably close to Lagos with 34 and Loulé with 26. Alcoutim only had one more, while Ourique and Olhão, both had three more.

In Figure AVI.12, Portimão highly increased their Accommodation Capacity with a 4483 rise, followed by Albufeira with 3253 and Loulé with 2877. The only county that saw the Capacity diminish was Alcoutim with -2, while Olhão only increased by 12 and São Brás de Alportel by 20.

As for Occupation Rate, Ourique had the biggest increase with 26,7%, São Brás de Alportel is second with 21% and Faro third with 16,2%. The biggest drop occurred in Aljustrel with -10,7% and Monchique with -10%, as seen in Figure AVI.13.

The Evolution 2011-2016 is on Table 4.6. It is possible to see that in these five years, does not exist a big disparity between the county's evolution, as almost every single one ranked bottom and top three in the 13 indicators. Albufeira ranked top three in 6 indicators, the most by any county, therefore maintaining the status as one of the most influenced by the airport evolution.

Table 4.6 – Evolution of the Socioeconomic Indicators from 2011 to 2016.

Source: Own elaboration.

Counties	Population Density	Education Level	Household Income	Economically Active Population	Employment Level	Companies Density	Sectorial Structure of Employment	Business Volume	Health	Tourist Attractions	Hotel Establishemnts	Accommodation Capacity	Occupation Rate
	Inhabitants / km²	%	€	%	%	Companies / km²	Nº	€ / km²	Doctors / km²	Attractions / km²	Nº	Nº	%
Aljustrel	-1,6	-2,8	82,8	-5,4	0,9	0,1	-275,0	232 617,9	0,0044	-0,0066	4,0	131,0	-10,7
Almodôvar	-0,7	-2,8	89,2	-14,0	-10,8	0,1	-525,0	13 153,2	0,0099	-0,0013	4,0	40,0	-2,0
Castro Verde	-0,3	-1,6	93,7	7,3	2,5	0,1	436,0	-301 442,9	-0,0017	-0,0053	4,0	38,0	-6,1
Mértola	-0,6	-1,9	14,0	-5,7	-13,7	0,0	-634,0	-38,7	0,0026	-0,0015	12,0	198,0	14,5
Ourique	-0,8	-2,2	40,9	-7,2	-7,9	0,1	-389,0	18 788,0	0	0	3,0	84,0	26,7
Albufeira	-2,4	-3,1	-2,5	4,6	8,1	9,0	-2 324,0	1 022 553,2	0,0499	-0,0426	35,0	3 253,0	8,2
Alcoutim	-0,9	1,1	74,5	-2,9	-6,2	0,0	-171,0	-2 346,6	0,0039	-0,0034	1,0	-2,0	12,0
Aljezur	-0,9	-4,7	-15,9	-10,8	-3,0	0,5	-702,0	34 034,1	0,0151	-0,0062	18,0	338,0	15,3
Castro Marim	-1,0	-3,2	-40,4	-11,7	-1,1	0,0	-712,0	-17 023,3	0,0103	0	10,0	650,0	16,2
Faro	-18,4	-7,3	22,5	-7,3	3,5	2,0	-6 527,0	639 534,7	0,3413	0,0297	7,0	66,0	16,2
Lagoa	-2,0	-3,3	-15,4	-8,6	4,8	9,8	-2 581,0	1 018 449,4	0,0787	-0,0225	4,0	2 786,0	10,5
Lagos	-1,4	-6,2	3,8	-12,4	3,6	3,9	-3 597,0	443 657,3	0,07	-0,0047	34,0	2 630,0	9,3
Loulé	-1,5	-3,3	6,1	-3,2	6,5	2,5	-11 126,0	282 333,3	0,0406	-0,0039	26,0	2 877,0	8,0
Monchique	-1,6	-1,8	33,2	-8,8	-5,2	0,1	-706,0	50 250,0	0,0072	0	5,0	289,0	-10,0
Olhão	-1,5	-5,9	-34,2	-23,7	-0,2	2,2	-5 037,0	325 900,0	0,1078	0,0231	3,0	12,0	5,1
Portimão	-1,0	-5,5	19,1	-10,2	2,7	0,9	-6 743,0	329 346,2	0,3082	-0,011	15,0	4 483,0	5,8
São Brás de Alportel	-0,7	-7,5	-83,9	-21,2	-0,6	1,8	-1 431,0	83 920,0	0,0397	-0,0066	4,0	20,0	21,0
Silves	-0,9	-4,6	-26,3	-20,7	-1,2	0,9	-3 884,0	799,7	0,0103	0,0059	10,0	1 283,0	3,5
Tavira	-1,4	-5,2	8,5	-10,9	4,0	1,4	-2 397,0	76 108,4	0,021	0,0099	14,0	74,0	5,9
Vila Real de Santo António	-1,6	-4,8	16,2	-11,9	1,6	-0,2	-2 105,0	867 677,4	0,1132	0,0162	10,0	572,0	4,9

4.5 Layout Comparison

Using Amsterdam Schiphol and Paris Charles de Gaulle airports as examples, a comparison between the layouts of both airports and the layout that characterises Faro should be drawn.

In Amsterdam case, Schiphol has a town that centres with mixed land use, office, retail, hotel, pedestrian-friendly shopping areas and a strengthened urban core. The city is an example of green urbanism, and regarding the preservers, there is also a development project built on the city's old waterworks site [46]. Schiphol is considered a "mega-Aerotropolis", as its advantages are regional land use and transportation planning and implementation across jurisdictions. Schiphol is a major node of industry, businesses, firms, offices and jobs; however, unlike a regional city centre, does not have housing for its employees. That is where the new town of Zuidas plays a major role, reachable only within "six-minute drive or train ride" of Schiphol and 15 minutes to Amsterdam's city centre and canal district [47]. The three areas can be observed in Figure 4.2. The housing location's proximity to the regional city's employment due to mixed land-use and public transit compensates for the lack of housing in the airport area itself [46]. On top of this, Schiphol provides corridors with trains, rail, shuttles, buses that facilitate access to key areas within the regional city. As for Zuidas, the train station is set to be the second main station in Amsterdam and the fifth busiest in the country, regarding passengers, with connections to Schiphol Airport and more European cities such as Paris or Brussels.

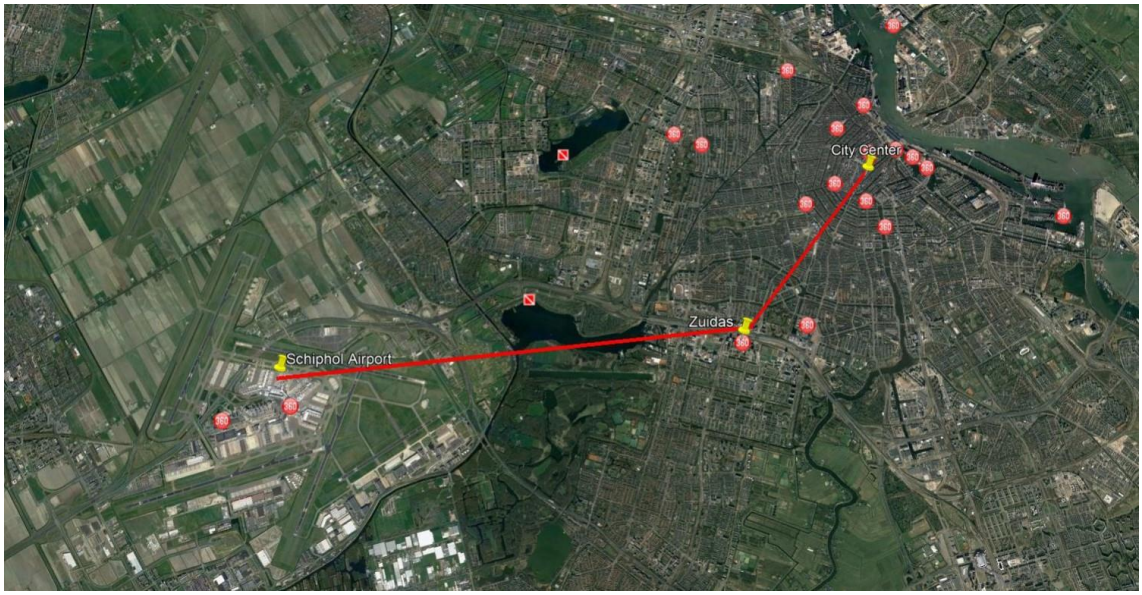

Figure 4.2 – Amsterdam Schiphol and Zuidas

Source: Adapted from Google Earth

Paris CDG is the largest airport in France and the second in Europe, therefore has a massive influence on what an Aerotropolis should look. The Roissy-CDG is the number one cargo hub in Europe and second in passengers. This area has been growing throughout the years, capitalising its potential, offering a great transport network, which includes five transport solutions for unique multimodal solutions (air, rail,

maritime, road, river). The transport network around the hub has some other advantages, as the adjoining highways and runways, and the rail connection puts CDG only a few hours away from several European cities. The region also has 70 inland ports just a few kilometres away, and for last, the closeness to large European ports (Le Havre, Rotterdam and Mediterranean) connect the airport with main routes to Africa and Asia [48].

There is a surrounding area that provides a rich and varied real-estate market supporting this major offer in transport, allowing creating new businesses parks and increasing the density of existing parks. The area is dynamic and has international reach, which favours commercial, hotel and leisure facilities. For all these reasons, Paris Charles de Gaulle represents of the economic engines of the region as it attracts a large number of companies specialised in services, new technologies, automotive and aeronautic industries, as well as in luxury and design [48]. A map showing the region and key points is presented in Figure 4.3.

Figure 4.3 – Roissy- CDG

Source: Adapted from Google Earth

In these two examples, one must keep in mind that both are operational Aerotropolis, meaning they currently use this dynamic model successfully and have made changes over the years to reach this stage, and still have further developments projected. Also, it is important to refer that Amsterdam and Paris are major cities, while Faro is considered a medium-sized city.

The layout of FAO is presented in the previous chapter, it is possible to state that it remained very similar over the years. Comparing with the other two, the current layout, Faro lacks housing in the proximity, multimodal connections and a clearer district to where the idea must grow and develop. Faro is not currently becoming an Aerotropolis, but it is possible, using the data compiled and the comparisons to determine: firstly if it is possible, and secondly, if it is viable. Figure 4.4 presents a sobrepositionon of the year 2016 over 2011 and one can observe that the layout has not changed considerably over the years.

Figure 4.4 – Sobreposition of Faro Layout (2016 over 2011)
Source: Adapted from Google Earth

4.6 General Assessment

An assessment can be made reaching this stage. Table 4.7 constitutes the description of the urban form of the two previously discussed Aerotropolis (Paris and Amsterdam) and a description of Faro in is current state and from there, pinpoint the differences and changes that can or should be made in this airport to follow a sustainable and efficient growth as an Aerotropolis. The main goal here is to establish the strong and weak points that constitute each Aerotropolis, including treating Faro as one in this specific phase to identify the gaps, and after that reaching a final statement on its status.

Faro, as a medium-sized city, has less influence and movements. Therefore not everything in detail can be expected to be replicated, or if so, it should be made on a smaller scale.

Table 4.7 –Assessing the urban form of Aerotropolis
Source: Adapted from [46]

Building Block	Centres	Districts	Preserves	Corridors	Assessment
Zuidas, Aalsmeer, Amsterdam (Schiphol)	Town centres with mixed land-use, offices, retail, hotels	Amsterdam Airport Area (AAA) Zuidas (business district), Aalsmeer ("global floral hub") airport city district	Built on a drained lake; agriculture/ Greenbelt; World's "green floral hub."	Multimodal, roads, trains, rail, Aalsmeer shuttle, Zuidas	District with regional centres; housing in proximity; district is in a regional city with multimodal mobility
Charles de Gaulle, Roissy, Paris	Mixed land-use with offices, hotels, sporting cultures	Roissy-en-France, Charles de Gaulle	Built around an area with floor space ranging from several thousands of km^2	Multimodal, roads, rail, rivers, boat, maritime	High density, potential housing in proximity; a regional city with multimodal mobility
Faro	Mixed land-use with hotels, offices	Faro, Algarve and Baixo Alentejo	Partially covered by the sea; cannot be expanded	Roads, buses connecting to the Algarve region, Lisbon and Seville	Regional city, lacking housing in proximity, a business district with some multimodal mobility

Analysing the table, it stands out how well thought out Paris and Amsterdam are, while Faro lacks some infrastructures. Faro has two restraints: it cannot be expanded, and it is only a medium-sized city. However, Faro needs improvement on their infrastructure to support movements as the airport, currently exceeds its capacity, surpassing the six million passengers a year. It is crucial to establish a business district strong enough to attract important stakeholders and create housing in the proximity to become an efficient Aerotropolis, within the Catchment Area,.

According to the results of the socioeconomic indicators, there are counties, that could operate as a business hub: Faro, Albufeira and Portimão ranked high in indicators such as Companies Density, Business Volume and Population Density. Faro is closest to the airport and seems to be the most viable option, while Loulé being close and recording good results on most indicators could be an alternative too.

The next step in creating an Aerotropolis plan is to ensure that there are connections that efficiently serve the area. Right now, Faro airport only offers roads and buses routes to the city centre, Seville, Lisbon and some parts along the Algarve. Geographically covered by the sea and close to Africa, the creation of a port infrastructure would contribute to an ideal Aerotropolis planning in this city, because it would create new ways of cargo and passenger routes to Northern Africa, something that would boost the economy in this area. Faro airport also lacks a train connection, something that most Aerotropolis offer; however, there is a train station within seven kilometres that connect Faro to everywhere within the Catchment Area and most important cities in the country.

In Figure 4.5 is presented a possible planning schematic to adapt Faro into an Aerotropolis.

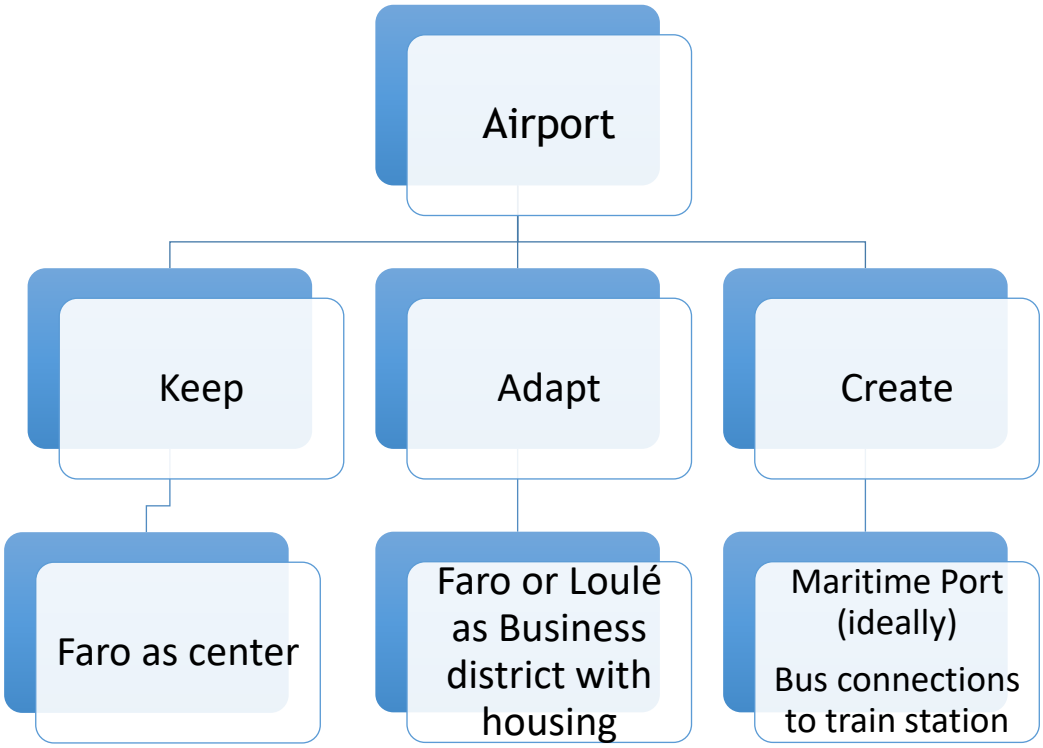

Figure 4.5 – Faro Aerotropolis Schematic
Source: Own elaboration

The assessment concludes that Faro can be adapted into a medium-sized Aerotropolis, like (unless the scale, of course) the mega-Aerotropolis of Paris and Amsterdam. The airport and region show many potentials to be an attractive site, not just for tourism, but also for companies. As for right now, Faro is in the brink of collapse due to the exceed of passengers and movements limits, as is Lisbon.

There has been an on-going debate about a new airport to serve Portugal, and Beja airport is an option to keep in mind, something that would help to relieve the traffic in Faro and Lisbon.
As a result of this work, it is possible to conclude that although it is possible to make adjustments in the airport to help increase efficiency. The ideal Aerotropolis plan would oblige to make more changes and

create more infrastructures (such as train connection from and to the airport) that nowadays are not considered viable, but the presented plan reduces the costs and also the drastic changes, and therefore making Faro Aerotropolis be a viable and possible option for the future.

4.7 Conclusions

In this chapter, a discussion of the results is made according to the research developed earlier. Working with the software and data gathering and through several steps, it was possible to explore various aspects of the Catchment Area towards the main goal, such as:

- Establish a temporal scenario that enables accurate data gathering to provide results that are valid to the research. Some information was complicated to gather, including from the proper channels, such as INE, that was the main reason that led to the choice of such temporal scenarios;
- The determination of the Catchment Area, using a previous work [44], was essential to identify the counties within the limits of the Area and thoroughly study them in the three chosen temporal scenarios;
- Setting the counties, the Evaluation of these twenty counties was made through socioeconomic indicators. First, data gathering according to thirteen indicators in years 2001, 2011 and 2016 was examined and discussed, highlighting the top and bottom counties in each indicator. Next step was to take these data and create an Evolution table, to observe the growth, or lack of, throughout the years. For this purpose, three tables were created, with Evolution from 2001 to 2011, 2001 to 2016 and 2011 to 2016;
- Since Faro is not an Aerotropolis, it was important to identify the differences between its Layout and others from operational Aerotropolis. The choice fell on Paris CDG and Amsterdam Schiphol, as two great examples of mega-Aerotropolis in Europe. It was possible to see how they identified as urban forms of Aerotropolis, using this comparison, as regional city building blocks and try to apply that form in a medium-sized city like Faro;
- After this, all layers are set to complete a general assessment of the airport and draw a conclusion to this work. Analysing the results of the Catchment Area Determination, Catchment Area Evaluation and the Layout Comparison, a plan was elaborated to a possible and viable Aerotropolis in Faro relying on specific targets, (even though this airport has some contingencies such as the exceed of the passenger flow limit and no possibility of expansion). Attracting major stakeholders to an already high-demand region, create connections to reach more important places, whether it is through passengers or cargo and ultimately improve the efficiency of the Faro Airport.

This chapter concludes all research and results aimed at the work. Aerotropolis is the way of the future, and it is important to create more operational Aerotropolis, whether made from scratch or adapted. This model will help to develop the way people fly, and ultimately live.

With efficient planning, an Aerotropolis can help solve some of the problems nowadays, like the exceeding air traffic, contributing to a better dynamic in airports. Not every airport should adapt or change into an Aerotropolis, but when building a new airport, it should be taken in consideration to make any city aviation-oriented with the airport as its centre, creating corridors, preservers and jobs.

Based on the information given by the Flowchart 1.3., socioeconomic indicators were analyzed and interpreted, just like the examples of cities that already have Aerotropolis. After this considerations, a proposal was produced.

Chapter 5 – Conclusions

5.1 Dissertation Synthesis

The air transport is driving and shaping the business location and industrial development in the 21st century. The first chapter is a brief introduction to air transport evolution in recent years and how the emergence of Aerotropolis may be a new model in airports infrastructures.

The second chapter describes the State of the Art, beginning with the definition of Aerotropolis and Airport City, followed by the history of the concept, the kind of planning that should be made within the concept and the layout schematics of the Aerotropolis model.
The Catchment Area is also approached in this chapter, as its determination and evaluation are necessary to this work. In the first part of this chapter, the determination of such area is explained , answering the how and the why it's made. The second part consists of the type of evaluation that must be made, in this case through thirteen socioeconomic indicators. The ArcGIS software is also explored here, with examples over several industries to explain how this software helps with planning, development and analysis. This work is aimed at a proposal to adapt Faro airport into an Aerotropolis, to improve traffic flow (goods and passengers), while improving the region through this proved method.

In the third chapter, the case study is developed with the research, and subsequent results of the parameters defined earlier. It is possible to determine the Catchment Area and identify the counties that are within the area, using the transportation network built previously, and using a conventional GIS approach. The next step, the evaluation, is where through thirteen socioeconomic indicators, there is a thorough examination of such area, in the specific temporal scenarios. It also contains tables describing the airport evolution and the LCC impact throughout the years in the airport, followed by an analysis with figures that represent the layout throughout the years.

The fourth chapter presents the discussion of the results of this work obtained in the previous chapters, where it is possible to:

- Set the reasons to choose the right temporal scenarios to this work, using accurate data to provide vital information;
- Establish the twenty counties within the Catchment Area, and perform a study concerning evaluation using thirteen socioeconomic indicators. In this evaluation, in each indicator the top three counties are highlighted, as the bottom three, to observe a pattern throughout the temporal scenarios;
- Using two operational Aerotropolis as examples, describing their layouts and pointing the strong points that make them great examples and create that comparison with Faro airport, through images and layout characteristics;

- To reach a general assessment regarding the possibility and viability of an Aerotropolis-like adaptation, create a plan with suggestions about what to create, keep and adapt in the airport and region, forming a genuine proposal to submit.

5.2 Concluding Remarks

The main object of this dissertation is to determine the possibility and consequent viability of an adaptation of Faro airport into an Aerotropolis-like model, using a GIS conventional approach and evaluation of the Catchment Area.

This work has three specific objectives: use the socioeconomic indicators to evaluate the Catchment Area based on data from public and other sources. Compare the results of the indicators in three temporal scenarios (2001, 2011 and 2016); with layout examples of operational Aerotropolis combined with the gathered data, reach a general assessment on the possibility and viability of the Aerotropolis adaptation in this region.

These goals were achieved; however, more time would allow a broader and extensive discussion of the results; also it could be included older data of the Catchment Area to make a more deep analysis to the area and also create more correlations between the more temporal scenarios and the evolution of different businesses.

In terms of evaluation of the Catchment Area, the limitations to get actual data were determinant for choosing the temporal scenarios.

Gathering the socioeconomic indicators data was very time consuming, especially in 2016, because there was no census in that year and they had to be achieved in alternative sources. Some of the indicators also had to be calculated using secondary indicators to provide more accurate results.

Despite some difficulties and missteps, this work was rewarding in how it brings a new perspective, a modern one, to an ever-evolving region.

5.3 Prospects for Future Work

The air transport sector is shaping new business economics, especially how airports are driving a new age in urban and industrial development. Efficiency is key nowadays, and airports are aware that to achieve good rankings airports, and the surrounding regions must add value to the airport and create an impact in each other. Aerotropolis and airport city are concepts that are emerging rapidly, and it is necessary to take into consideration this phenomenon.

Therefore, future developments in this area must be focused on the following items:

- To research a new model to integrate all the information about airport performance with the Catchment Area component;
- To research the best indicators that can describe the characterisation of the region;
- To geo-refer all the data with GIS software;
- To extend the transportation network to other modes of transport, as water and rail transport;
- To study the possibility and viability of an Aerotropolis both in Lisbon and Oporto, considering that both cities are of a higher dimension and importance to the country;
- To perform a study regarding the impact of using Beja as a commercial airport, helping Lisbon and Faro to relief the override of the movements limit.

References

[1] EUROCONTROL, “Challenges of Growth 2013 Task 7: European Air Traffic in 2050 Network Manager nominated by the European Commission,” 2013.

[2] Air Transport Action Group, “Economic growth : Aviation: Benefits Beyond Borders.” [Online]. Available: https://aviationbenefits.org/economic-growth. [Accessed: 03-Dec-2018].

[3] Rolls-Royce and Safran, “Powering Global Economic Growth, Employment, Trade Links, Tourism and Support for Sustainable Development Through Air Transport,” *Int. Air Transp. Assoc.*, vol. 16, p. 80, 2016.

[4] M. Dierikx, “Essay: Love from above Essay: Fostering growth in emerging markets Essay: Global travel for all Looking at the role aviation has played in developing social and cultural ties,” no. April, 2014.

[5] York Aviation, “The social and economic impact of Airports in Europe,” *Airports Counc. Int.*, no. January, pp. 353–354, 2004.

[6] P. Alves, P. Marchão, M. E. Baltazar, P. Almeida, and J. Silva, “Determination and Evaluation of an Airport Catchment Area: a Portuguese Case Study,” in *11th Annual Transports Study Group Conference*, 2014.

[7] Kasarda and John D., “Aerotropolis.” [Online]. Available: http://aerotropolis.com/airportcity/index.php/about/. [Accessed: 05-Dec-2018].

[8] DVM, “Faro International Airport Portugal - WE ARE DVM.” [Online]. Available: http://www.weare-dvm.com/en/portfolio/faro-international-airport. [Accessed: 05-Dec-2018].

[9] M. Mechanix, “Skyscraper Airport for City of Tomorrow | Modern Mechanix.” [Online]. Available: http://blog.modernmechanix.com/skyscraper-airport-for-city-of-tomorrow/. [Accessed: 05-Dec-2018].

[10] K.-J. Wang, W.-C. Hong, S.-H. Chen, and J.-T. Jiang, “Strategic development trend and key factors analysis of Airport City in Taiwan,” *J. Transp. Geogr.*, vol. 19, no. 4, pp. 807–820, Jul. 2011.

[11] J. D. Kasarda, “Entry to the Wiley-Blackwell Encyclopedia of Urban and Regional Studies.”

[12] J. D. Kasarda, “Welcome to Aerotropolis, the City of the Future,” *New Perspect. Q.*, vol. 32, no. 3, pp. 43–45, Jul. 2015.

[13] F. Paganelli and G. Luppino, “Transnational Strategy for Airport City Development,” Bologna, 2014.

[14] M. Guller and M. Guller, “CCDR-LVT Lisboa,” 2008.

[15] M. José and A. Peneda, “Critical Factors for the Development of Airport Cities,” Lisboa, 2010.

[16] R. Freestone and D. Baker, “Spatial Planning Models of Airport-Driven Urban

Development," *J. Plan. Lit.*, vol. 26, no. 3, pp. 263–279, Aug. 2011.

[17] J. D. Kasarda and M. H. Canon, *Doing Business 2015: Going Beyond Efficiency*. 2014.

[18] P. van der Horst, "Developing the Airport City and Aerotropolis - Drs.Pieter van der Hor…," 2014. [Online]. Available: https://www.slideshare.net/GlobalAirportCities14/pieter-van-der-horst-developing-the-airport-city-and-aerotropolis. [Accessed: 05-Dec-2018].

[19] V. Gollain, "Paris Charles de Gaulle airport area - our district - your success," 2014. [Online]. Available: https://www.slideshare.net/vincentgollain/paris-cdg-airport-area-our-district-your-success-january2014. [Accessed: 05-Dec-2018].

[20] J. D. Kasarda, "The Rise of the Aerotropolis," *Airport World Magazine*, Apr-2013.

[21] D. Kerr, *Eastern figures : Orient and empire in British writing*. Hong Kong University Press, 2008.

[22] Transport Canada, "Regional and Small Airports Study," 2004.

[23] D. Strobach, "Competition between airports with an application to the state of Baden-Wuerttember."

[24] A. Graham, *Managing airports : an international perspective*. Butterworth-Heinemann, 2008.

[25] P. Suau-Sanchez, G. Burghouwt, and M. Pallares-Barbera, "An appraisal of the CORINE land cover database in airport catchment area analysis using a GIS approach," 2014.

[26] J. D. Kasarda, *Logistics and the rise of aerotropolis, Real Estate Issues, Vol. 25, No. 4*. 2000.

[27] M. Arend, A. Bruns, and J. W. McCurry, "2007 GLOBAL INFRASTRUCTURE REPORT -- Site Selection magazine, September 2007." [Online]. Available: https://siteselection.com/issues/2007/sep/infrastructure/. [Accessed: 05-Dec-2018].

[28] M. Van Wijk, "Airports as Cityports in the City-region," Utrecht University, Utrecht, 2007.

[29] S. Maertens, "'Estimating the market power of airports-a European-wide approach,'" Berlin, 2010.

[30] J. MANN, "'Catchment Area,'" *Am. J. Psychiatry*, vol. 124, no. 10, pp. 1467–1467, 2014.

[31] E. Marcucci and V. Gatta, "Regional airport choice: Consumer behaviour and policy implications," *J. Transp. Geogr.*, vol. 19, no. 1, pp. 70–84, Jan. 2011.

[32] A. Graham, *Managing airports : an international perspective*. Butterworth-Heinemann, 2008.

[33] M. H. Thelle, T. T. Pedersen, and F. Harhoff, "Airport Competition in Europe," Copenhagen, 2012.

[34] R. Lieshout, "Measuring the size of an airport's catchment area," *J. Transp. Geogr.*, vol. 25, pp. 27–34, Nov. 2012.

[35] CAA, "Airport market power assessments: Catchment Area Analysis," 2011.

[36] ESRI, "ArcGIS Desktop 轻松入门," 2008. [Online]. Available:

http://desktop.arcgis.com/en/arcmap/. [Accessed: 06-Dec-2018].

[37] ESRI, “ArcGIS for Aviation: Airports | Ensure Your Operational Data Meets Regulatory Requirements.” [Online]. Available: https://www.esri.com/en-us/arcgis/products/arcgis-for-aviation-airports/overview. [Accessed: 06-Dec-2018].

[38] Grind GIS, “Importance of GIS in planning,” 2018. [Online]. Available: https://grindgis.com/gis/importance-of-gis-in-planning. [Accessed: 11-Dec-2018].

[39] ESRI, “Managing Enterprise Data with ArcGIS Server at Phoenix Sky Harbor Airport,” 2010. [Online]. Available: https://www.esri.com/news/arcnews/spring10articles/enterprise-gis.html. [Accessed: 06-Dec-2018].

[40] GISGeography, “Vector vs Raster: What’s the Difference Between GIS Spatial Data Types? - GIS Geography.” [Online]. Available: https://gisgeography.com/spatial-data-types-vector-raster/. [Accessed: 04-Feb-2019].

[41] Eurostat, “Background - Eurostat.” [Online]. Available: https://ec.europa.eu/eurostat/web/nuts/background. [Accessed: 26-Mar-2019].

[42] PORDATA, “PORDATA - O que são NUTS?” [Online]. Available: https://www.pordata.pt/O+que+sao+NUTS. [Accessed: 26-Mar-2019].

[43] T. Rosa, “Airports Performance and Efficiency Concerning Low-Cost Carriers Operation . An MCDA and SPSS analysis,” 2017.

[44] P. Alves, “Determination and Evaluation of an Airport Catchment Area: a Portuguese Case Study,” Universidade da Beira Interior, 2014.

[45] A.-A. de Portugal, “Kiss & Fly - Faro Airport,” *AeroportoFaro.pt*, Jul. 2016.

[46] R. Banai, “The aerotropolis: Urban sustainability perspectives from regional city,” *J. Transp. Land Use*, vol. 10, no. 1, pp. 357–373, 2016.

[47] A. Werner, “Four airports integrated in cities,” 2018. [Online]. Available: https://www.volvoce.com/global/en/spirit-magazine/constructing-an-aerotropolis/four-aerotropolis-examples/. [Accessed: 12-Apr-2019].

[48] Aerotropolis Europe, “Real Estate Roissy-CDG Paris–Charles de Gaulle : the ideal location for your company | Aerotropolis,” 2011. [Online]. Available: http://www.aerotropolis-europe.com/aerotropolis/roissycdg-europe2.html. [Accessed: 15-Apr-2019].

Annexe 1 – Evaluation Results

Case Study – Faro Airport

I – The Year 2001

This chapter contains the results of the evaluation of the Catchment Area in the form of tables and choropleth maps, using a conventional GIS approach. Here is presented the scenario of the year 2001.

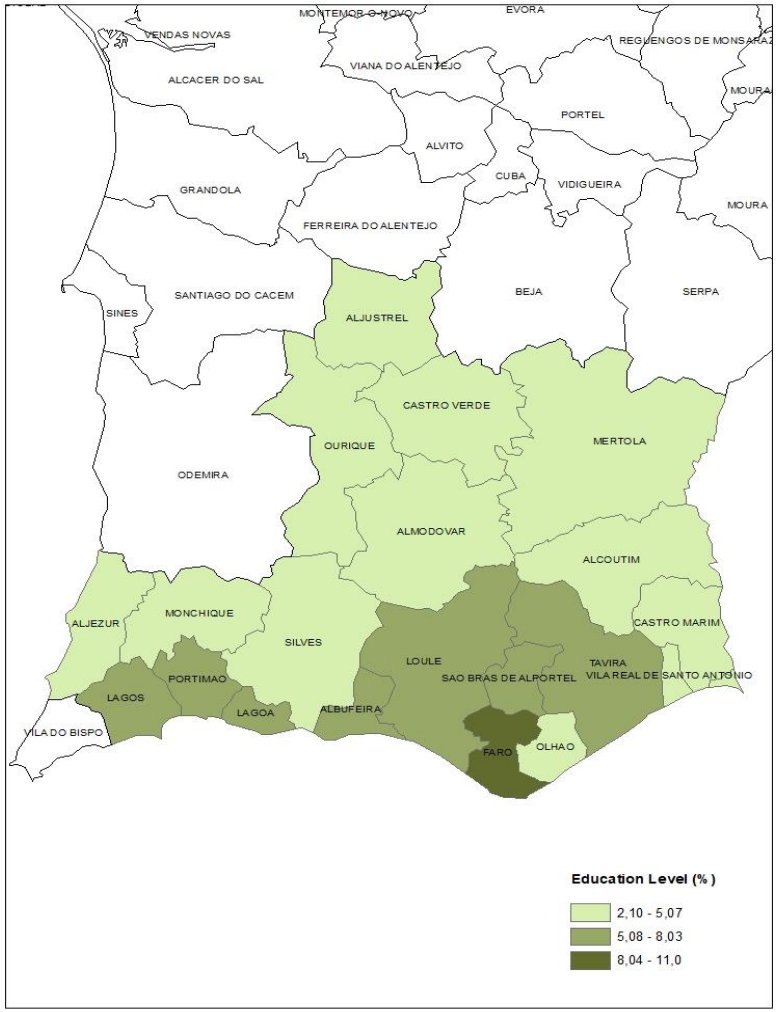

Figure AI.1 – Education Level

Source: Own elaboration

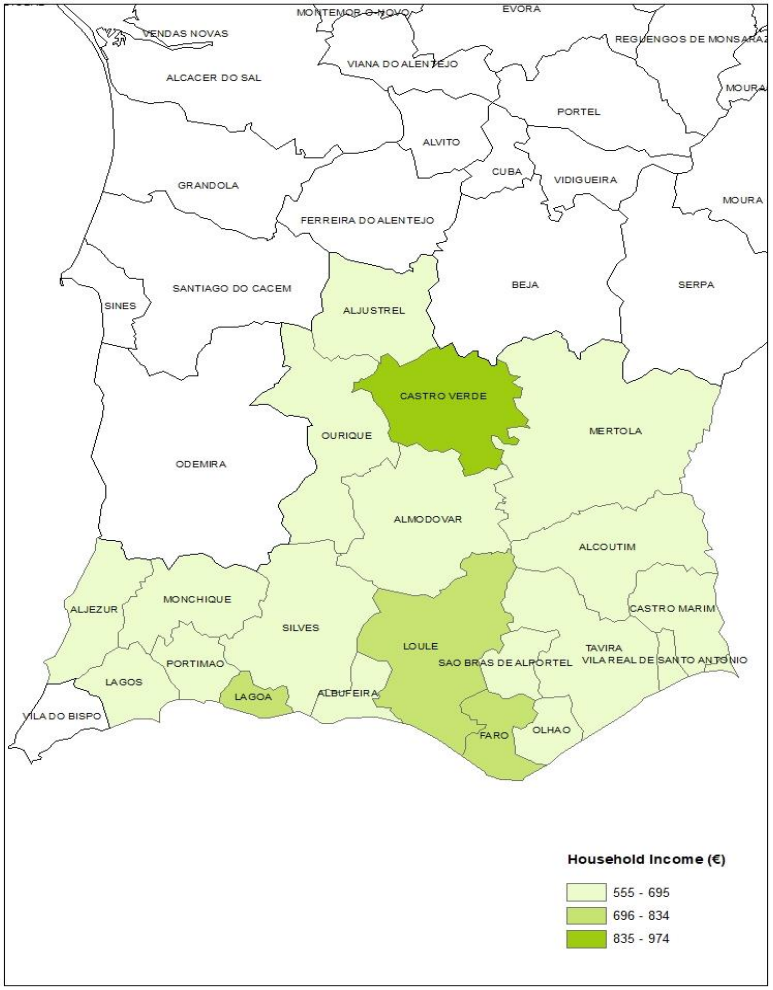

Figure AI.2 – Household Income

Source: Own elaboration

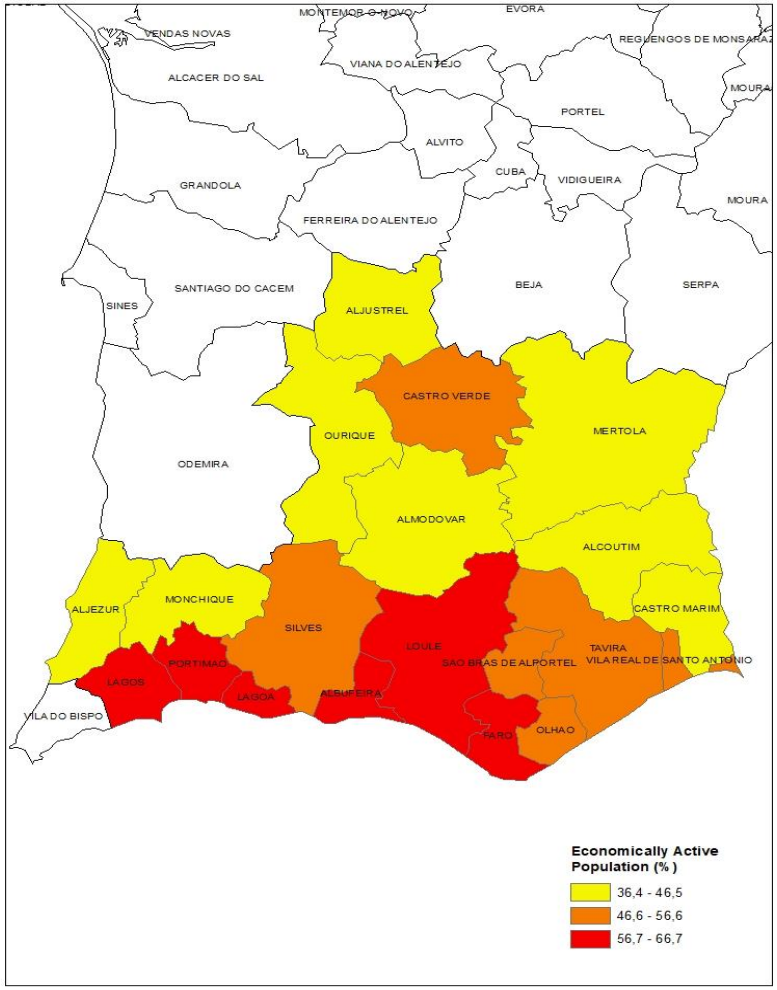

Figure AI.3 – Economically Active Population

Source: Own elaboration

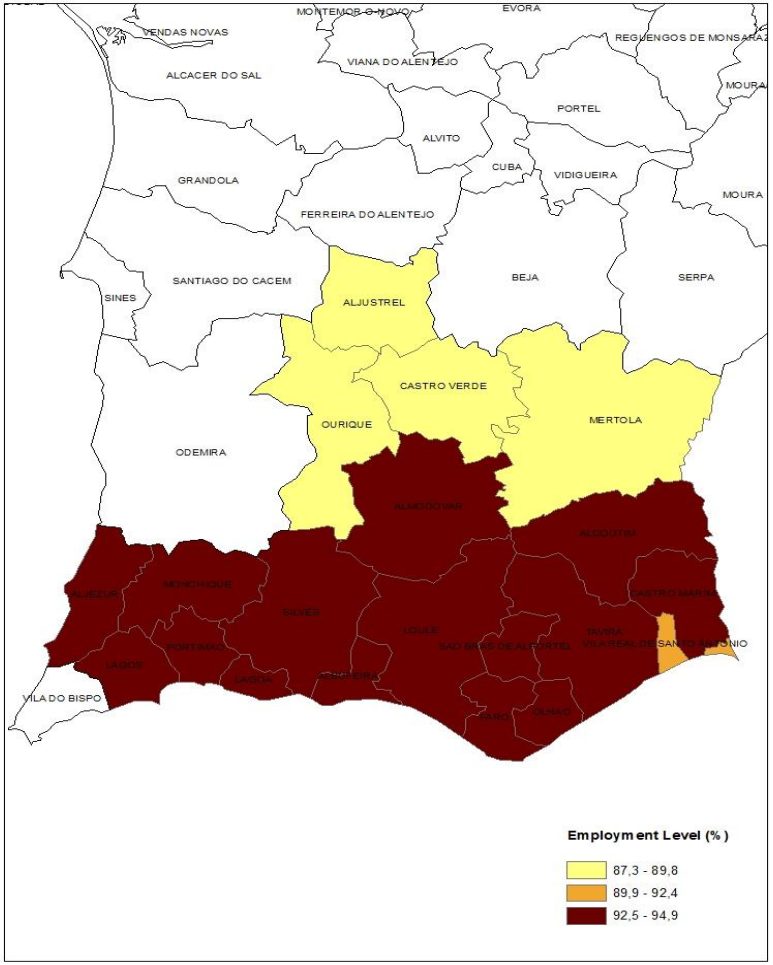

Figure AI.4 – Employment Level

Source: Own elaboration

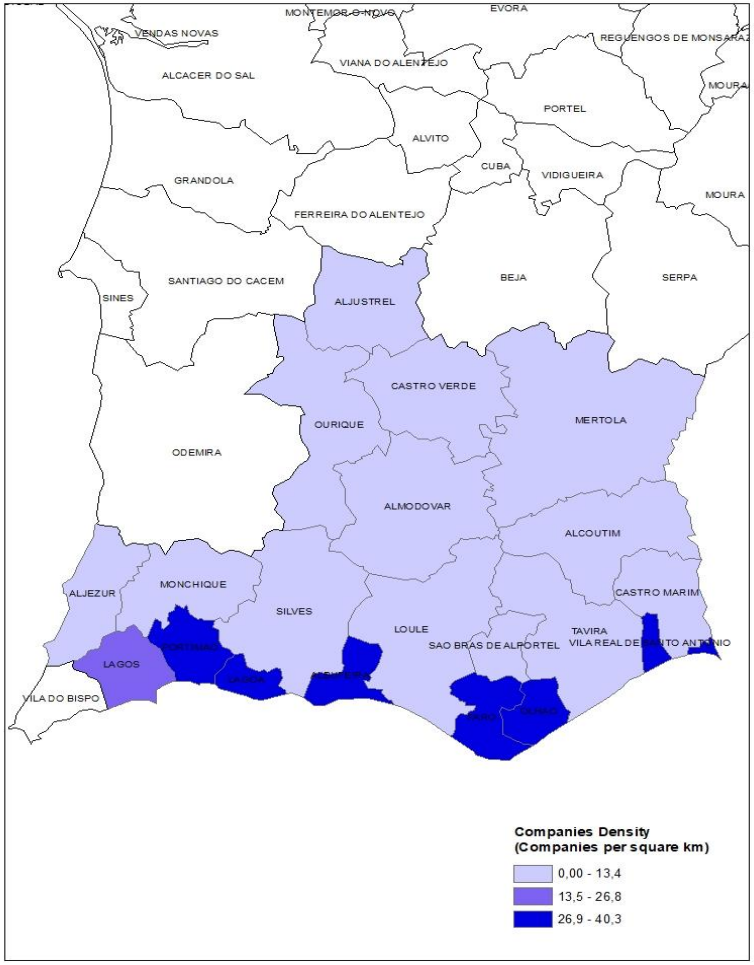

Figure AI.5 – Companies Density

Source: Own elaboration

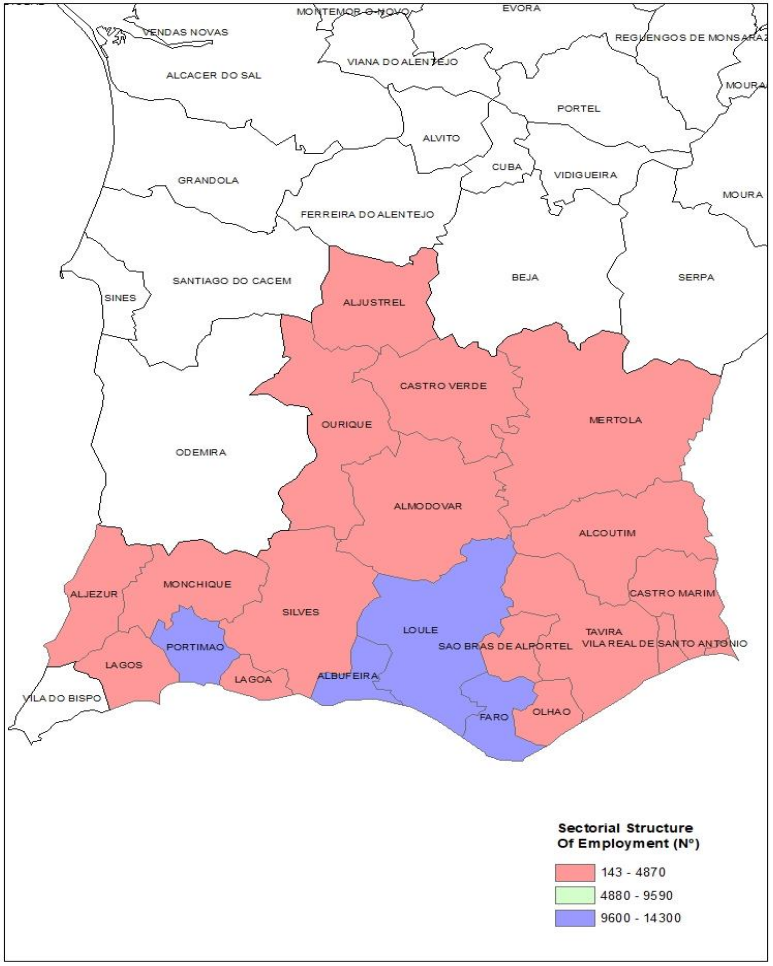

Figure AI.6 – Sectorial Structure of Employment

Source: Own elaboration

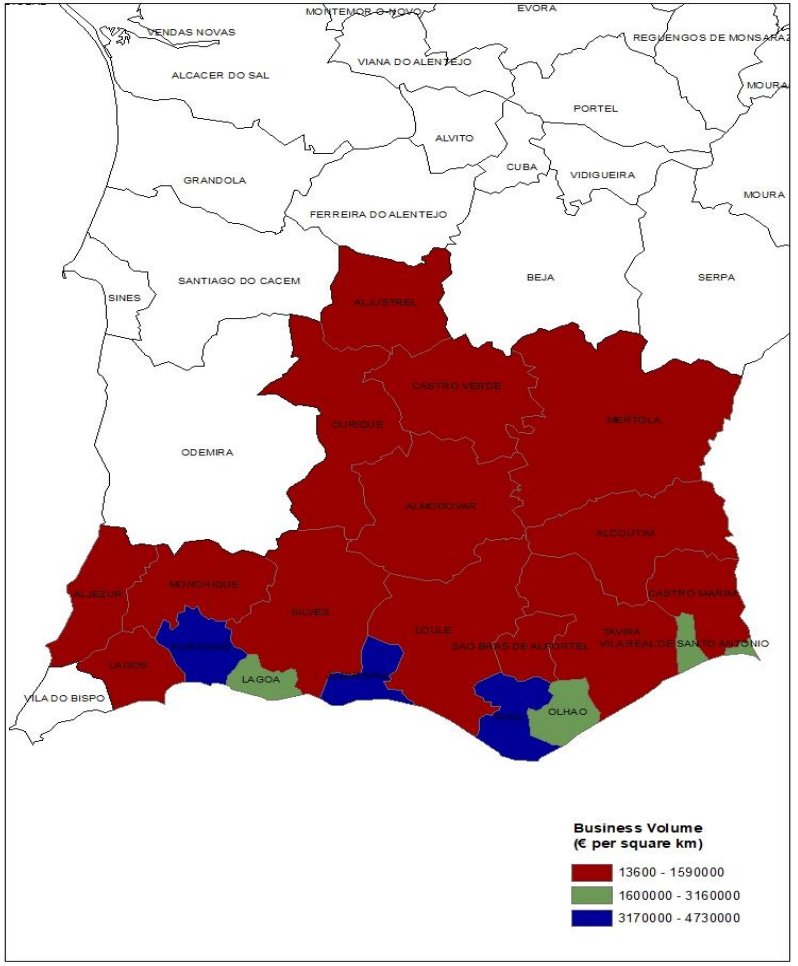

Figure AI.7 – Business Volume

Source: Own elaboration

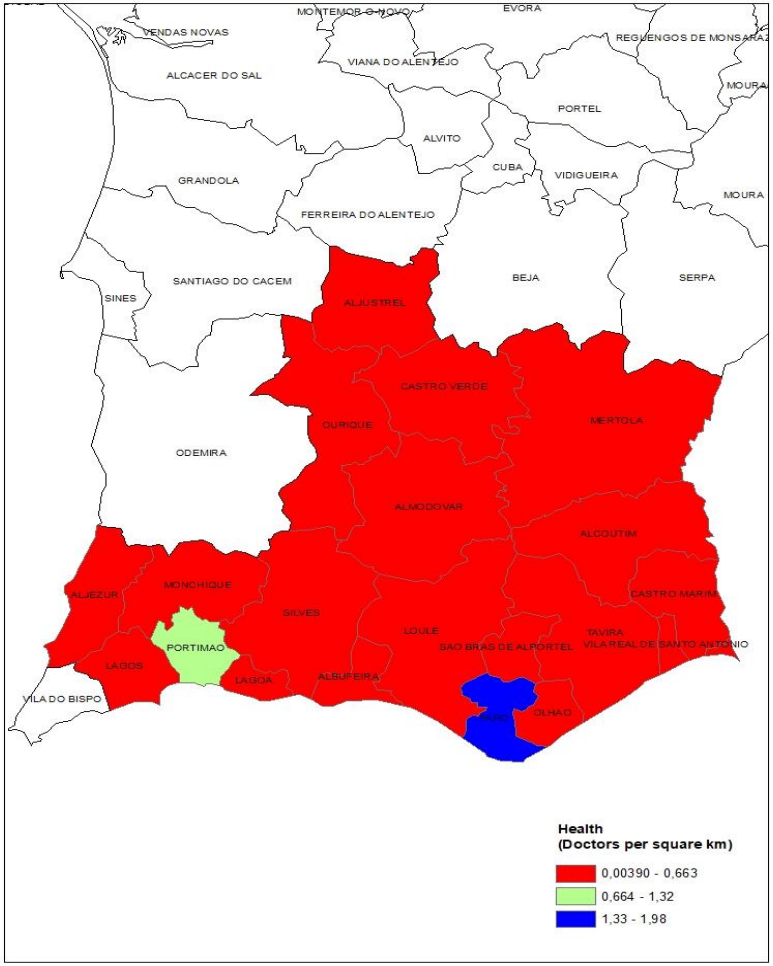

Figure AI.8 – Health

Source: Own elaboration

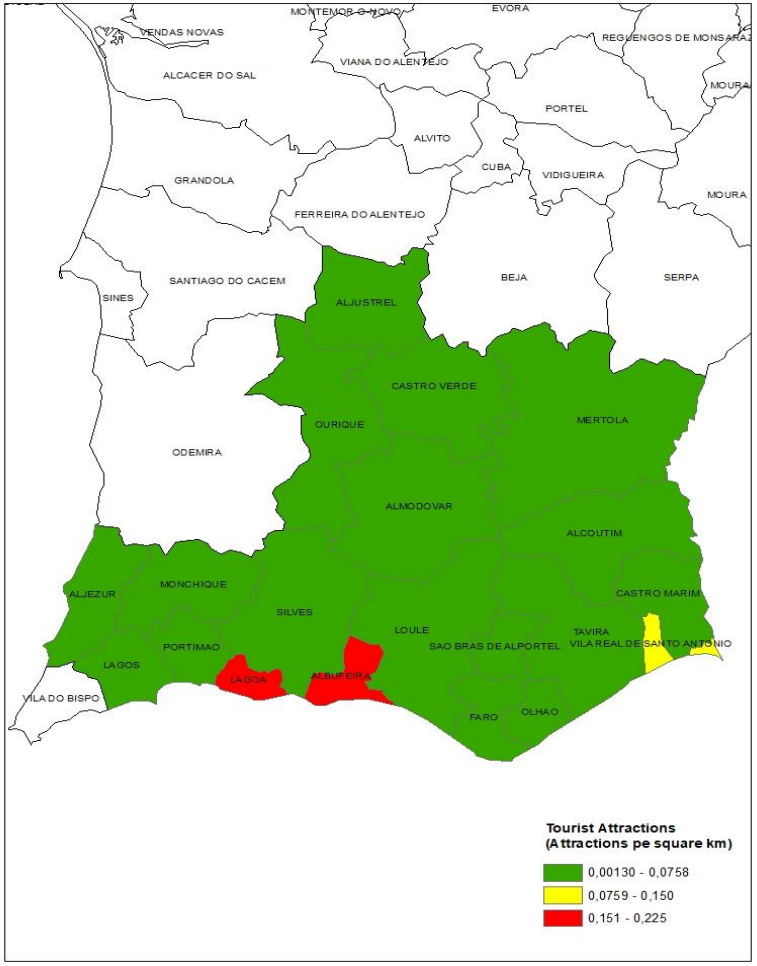

Figure AI.9 – Tourist Attractions

Source: Own elaboration

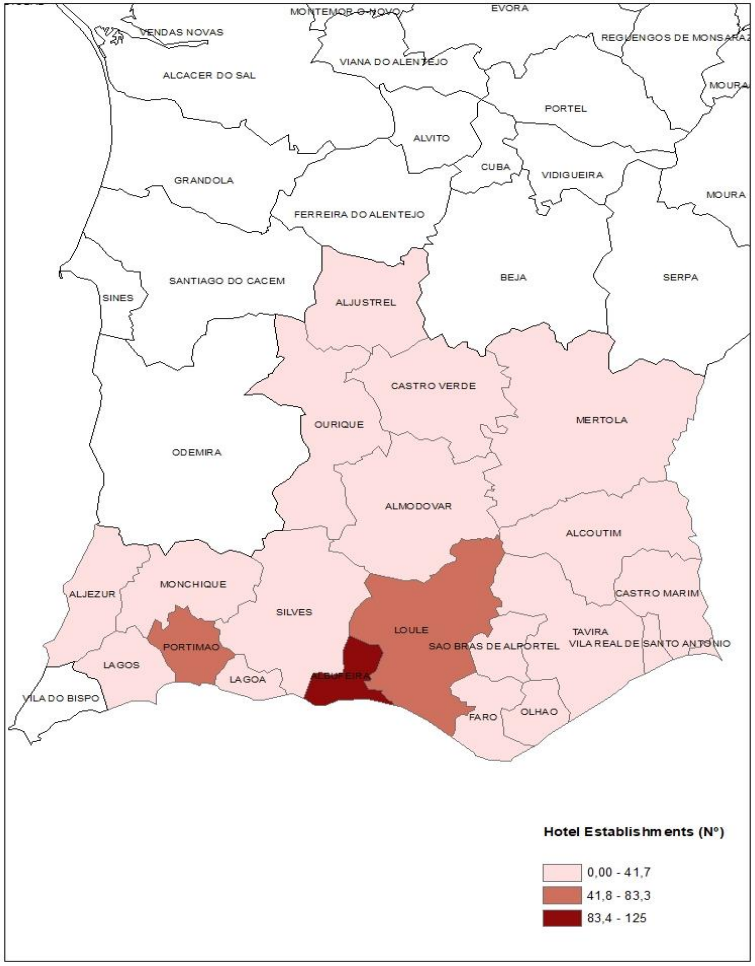

Figure AI.10 – Hotel Establishments

Source: Own elaboration

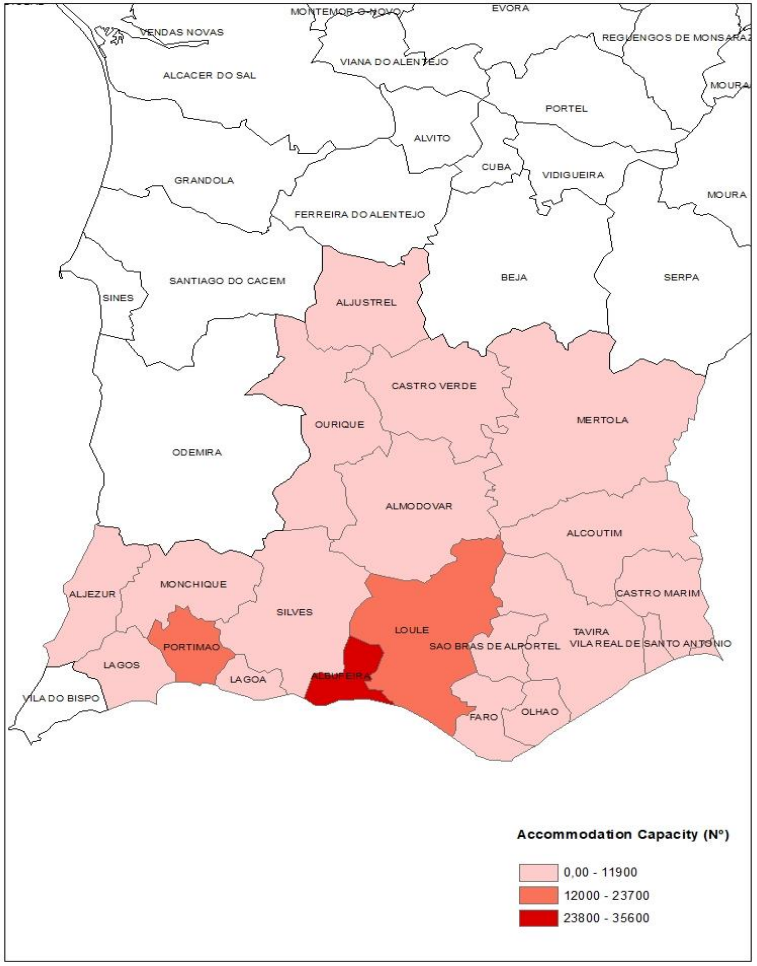

Figure AI.11 – Accommodation Capacity

Source: Own elaboration

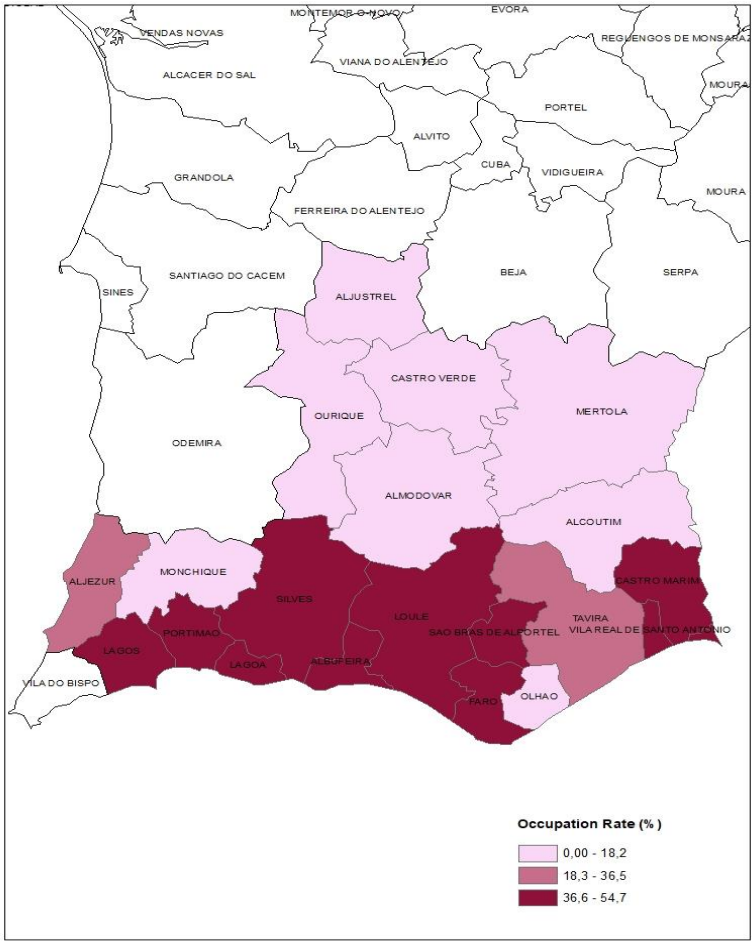

Figure AI.12 – Occupation Rate

Source: Own elaboration

II - The Year 2011

This chapter describes the results of the socioeconomic indicator for 2011.

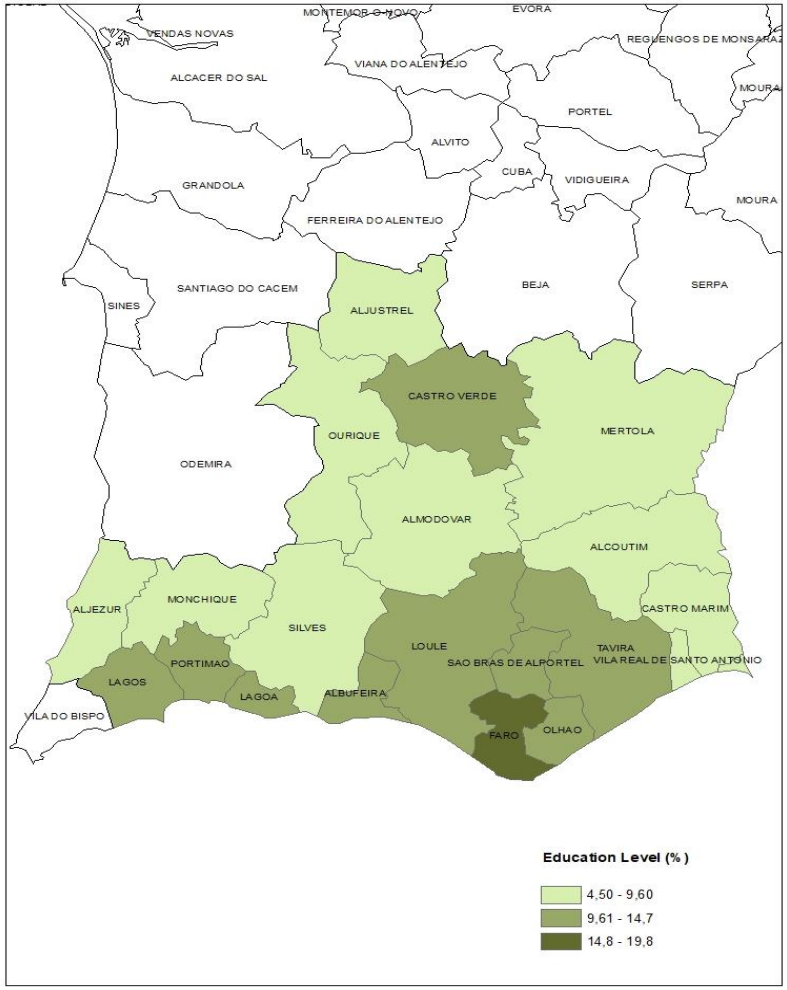

Figure AII.1 – Education Level

Source: Own elaboration

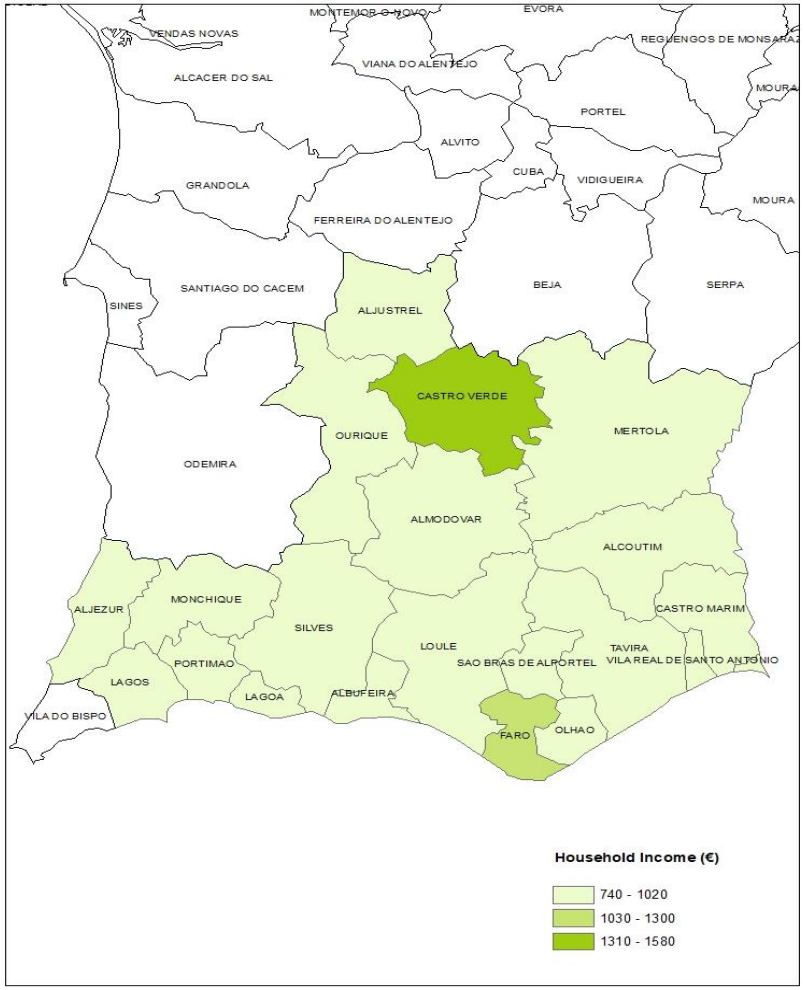

Figure AII.2 – Household Income

Source: Own elaboration

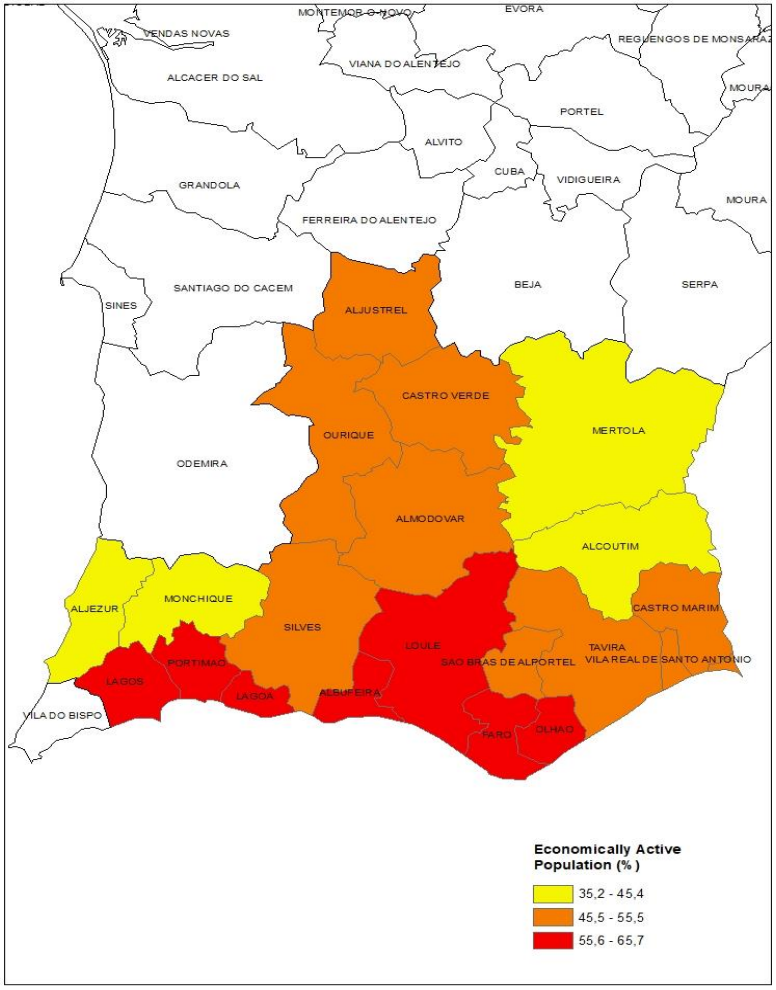

Figure AII.3 – Economically Active Population

Source: Own elaboration

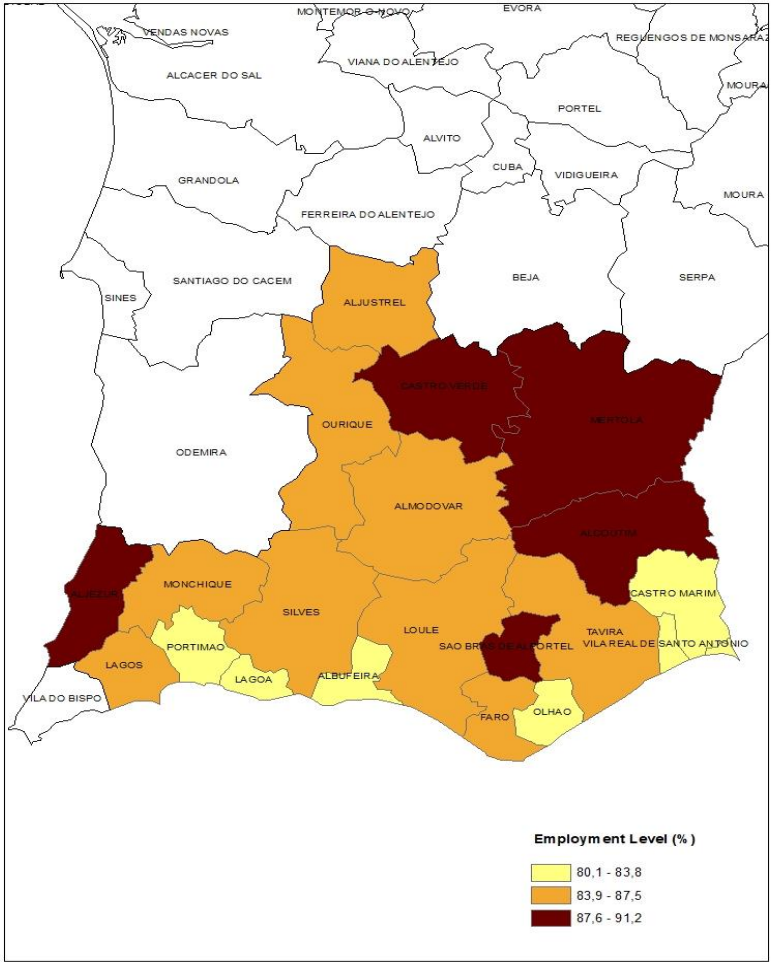

Figure AII.4 – Employment Level

Source: Own elaboration

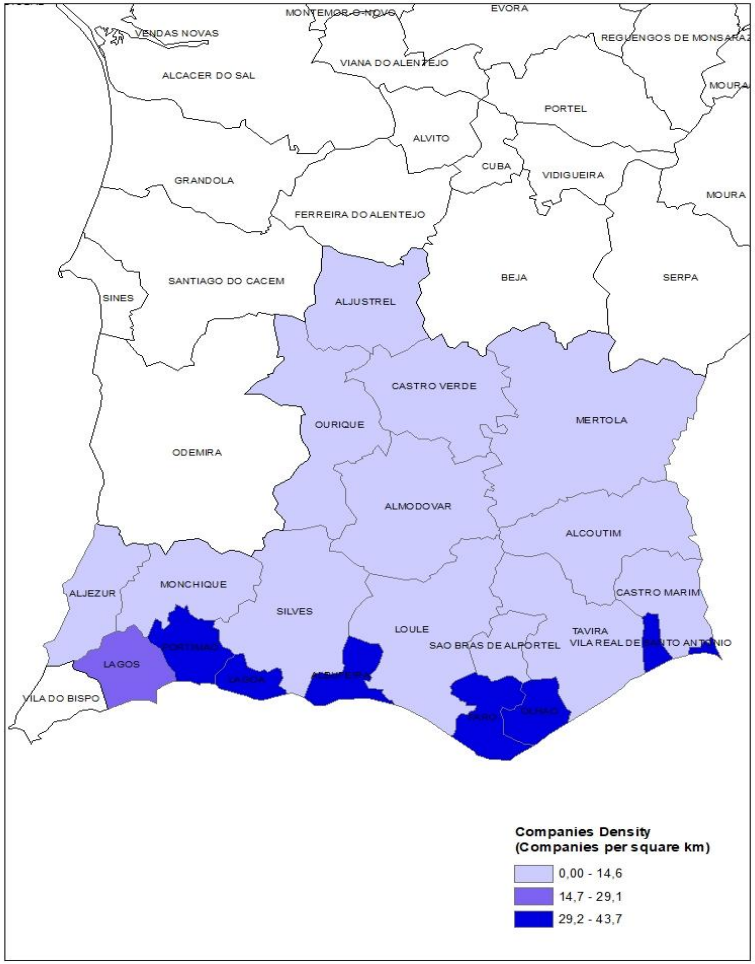

Figure AII.5 – Companies Density

Source: Own elaboration

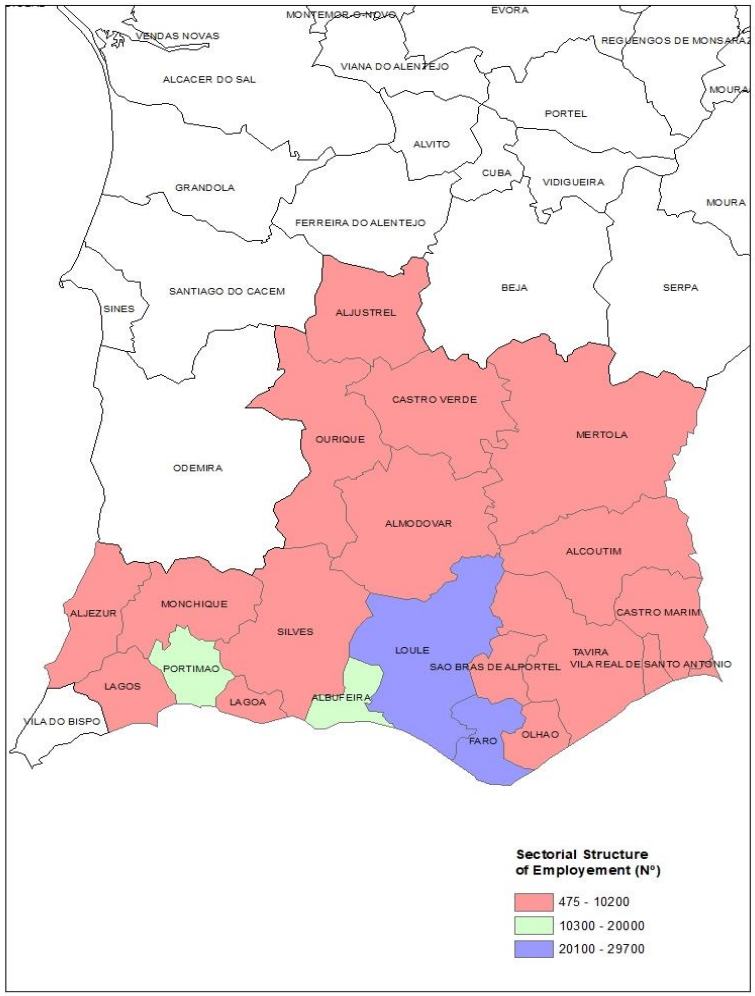

Figure AII.6 – Sectorial Structure of Employment

Source: Own elaboration

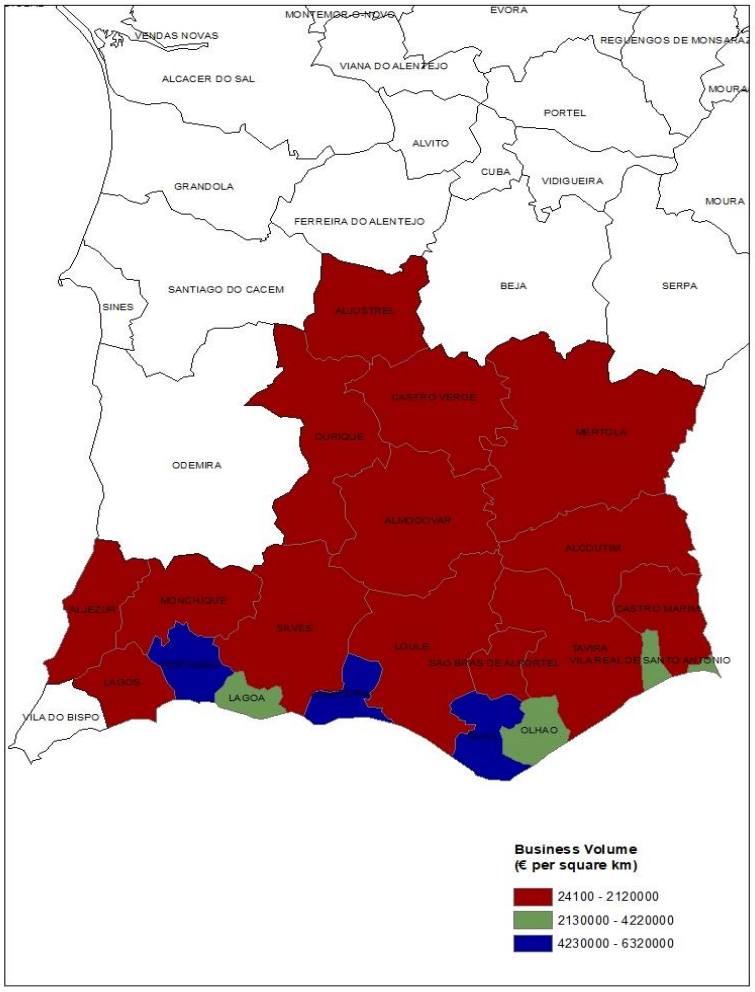

Figure AII.7 – Business Volume

Source: Own elaboration

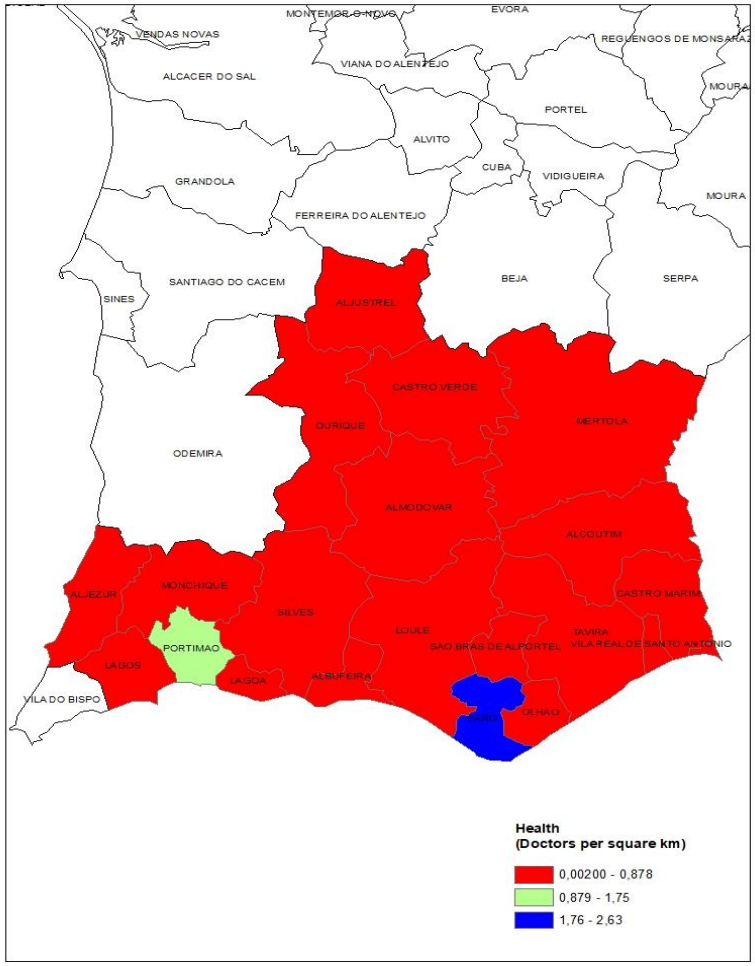

Figure AII.8 – Health

Source: Own elaboration

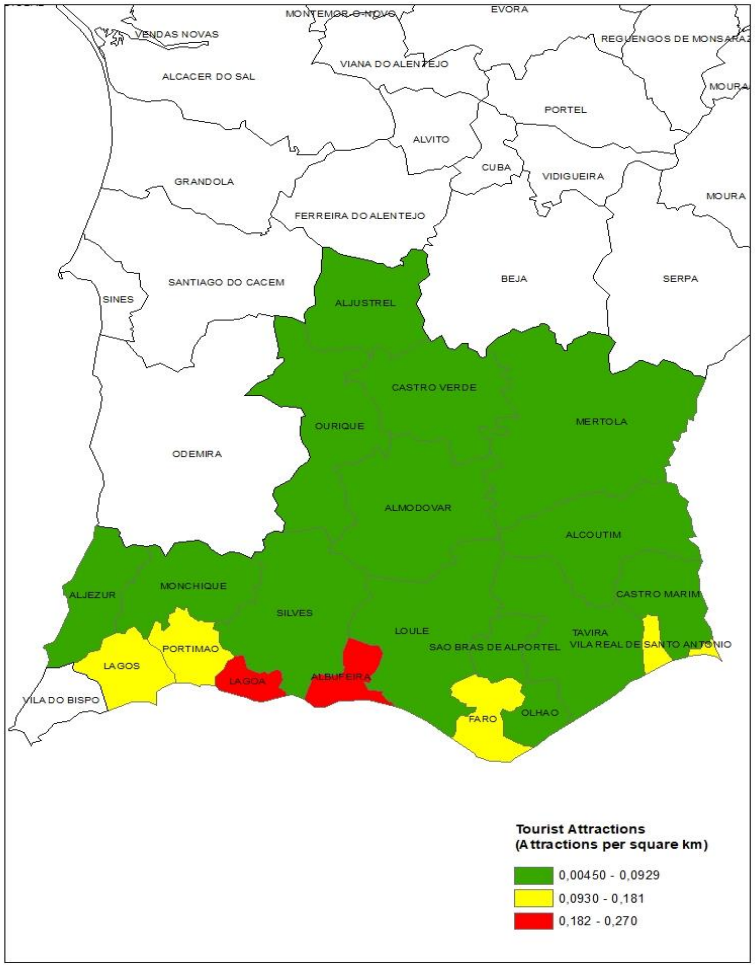

Figure AII.9 – Tourist Attractions

Source: Own elaboration

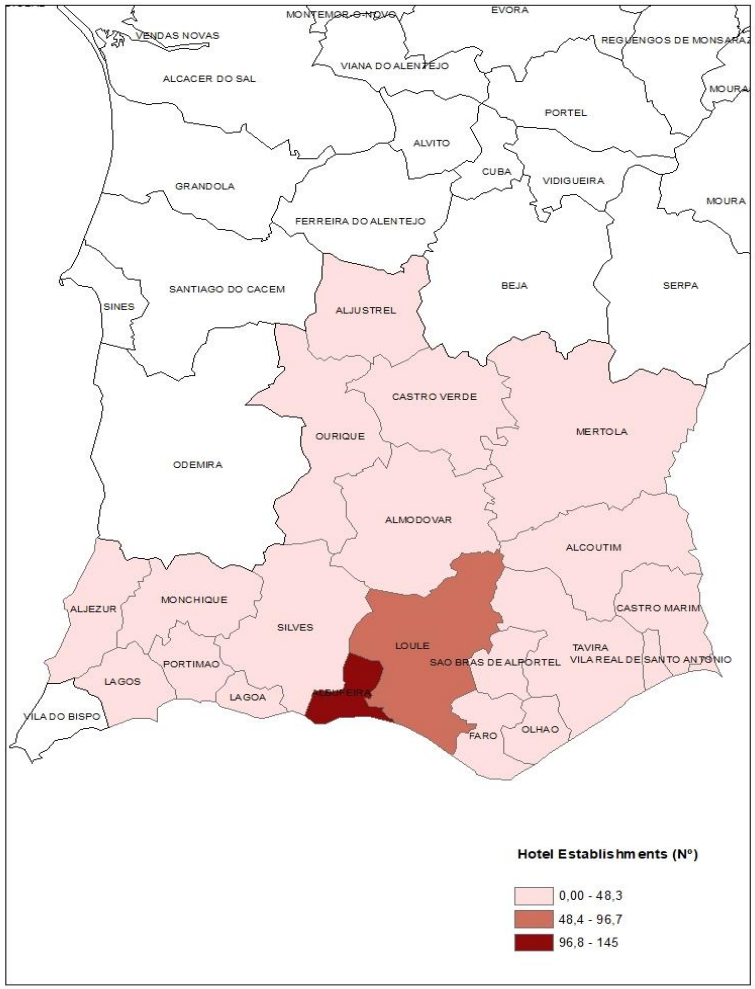

Figure AII.10 – Hotel Establishments

Source: Own elaboration

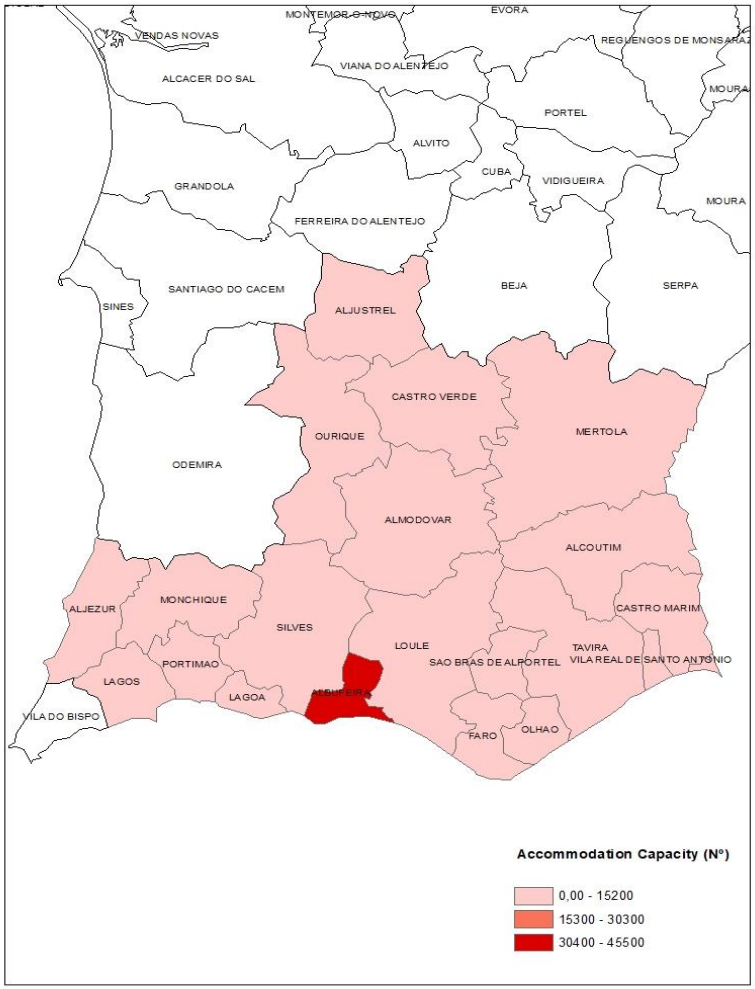

Figure AII.11 – Accommodation Capacity

Source: Own elaboration

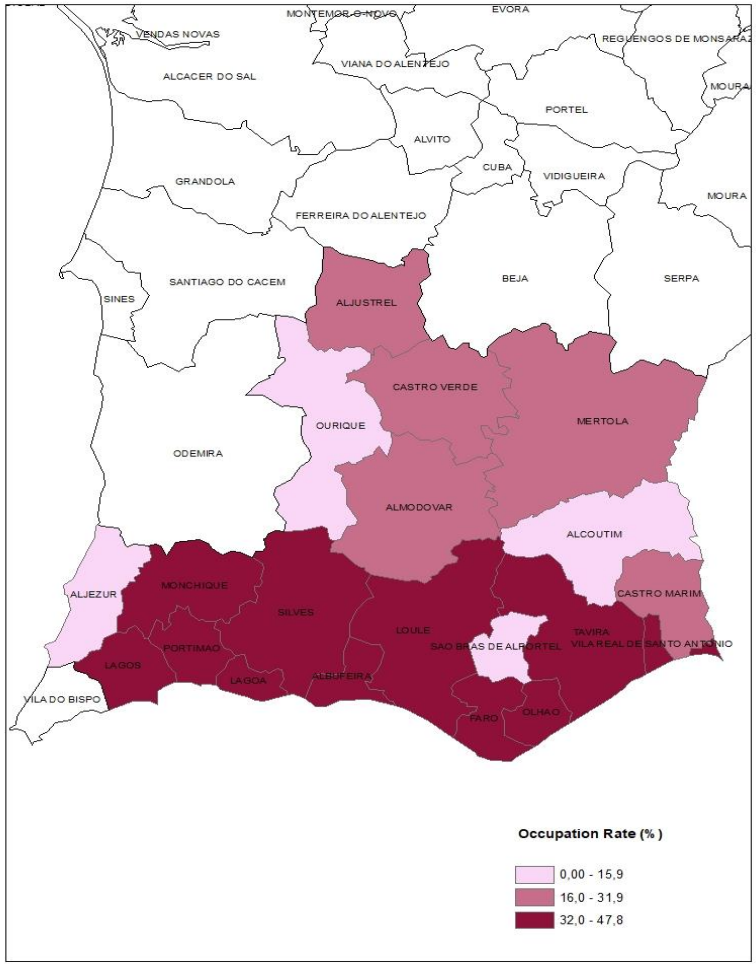

Figure AII.12 – Occupation Rate

Source: Own elaboration

III – The Year 2016

This chapter describes the results of the socioeconomic indicator for 2016.

Figure AIII.1 – Education Level

Source: Own elaboration

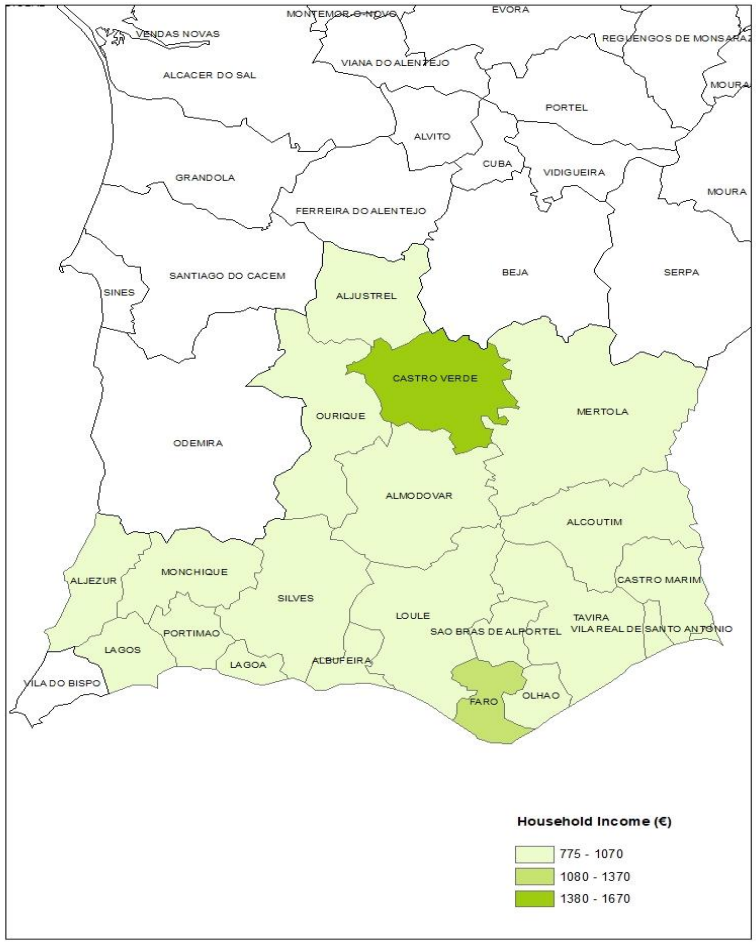

Figure AIII.2 – Household Income

Source: Own elaboration

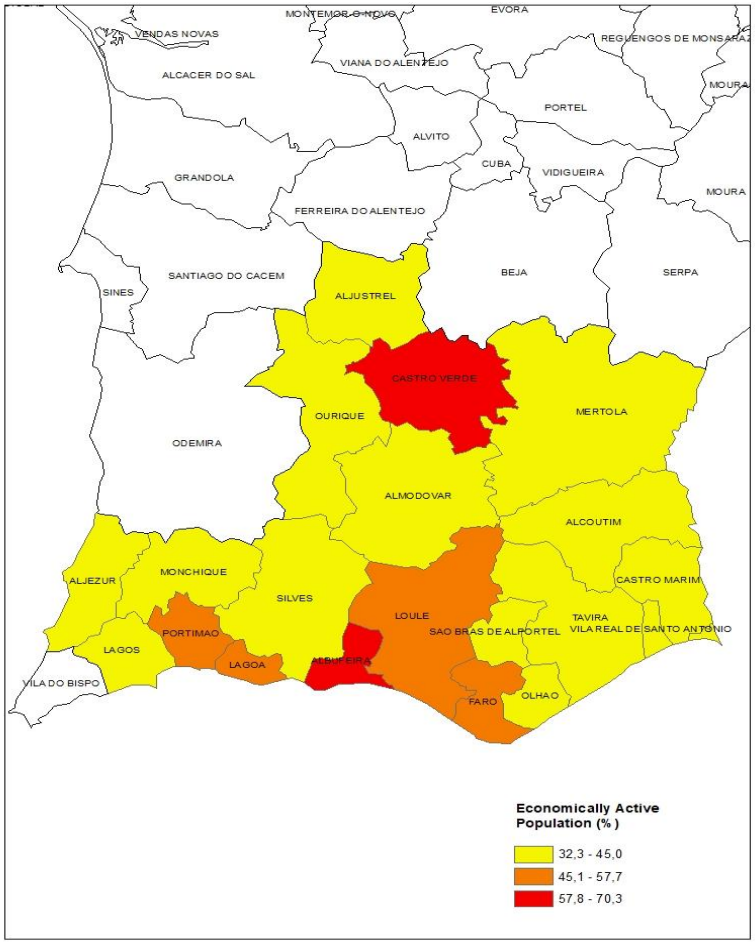

Figure AIII.3 – Economically Active Population

Source: Own elaboration

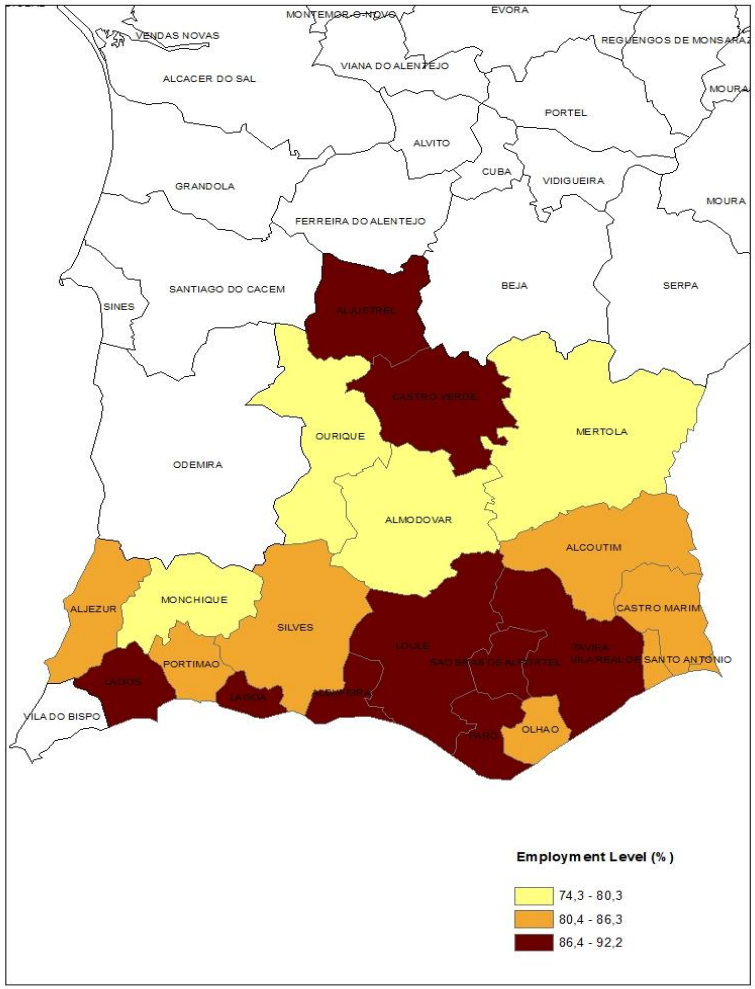

Figure AIII.4 – Employment Level

Source: Own elaboration

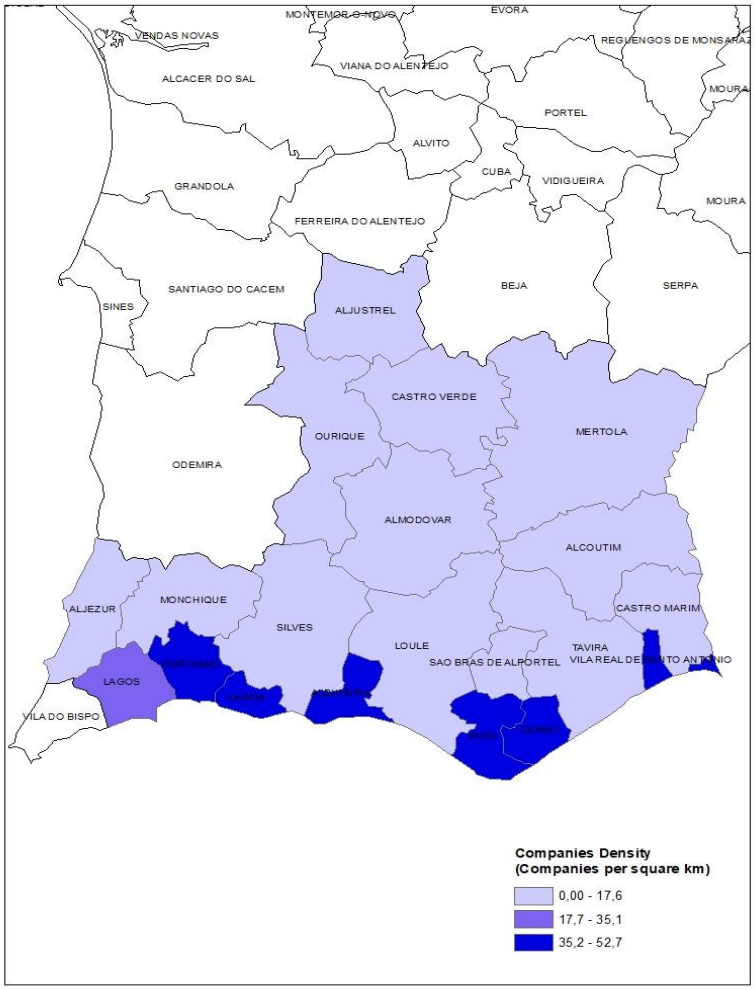

Figure AIII.5 – Companies Density

Source: Own elaboration

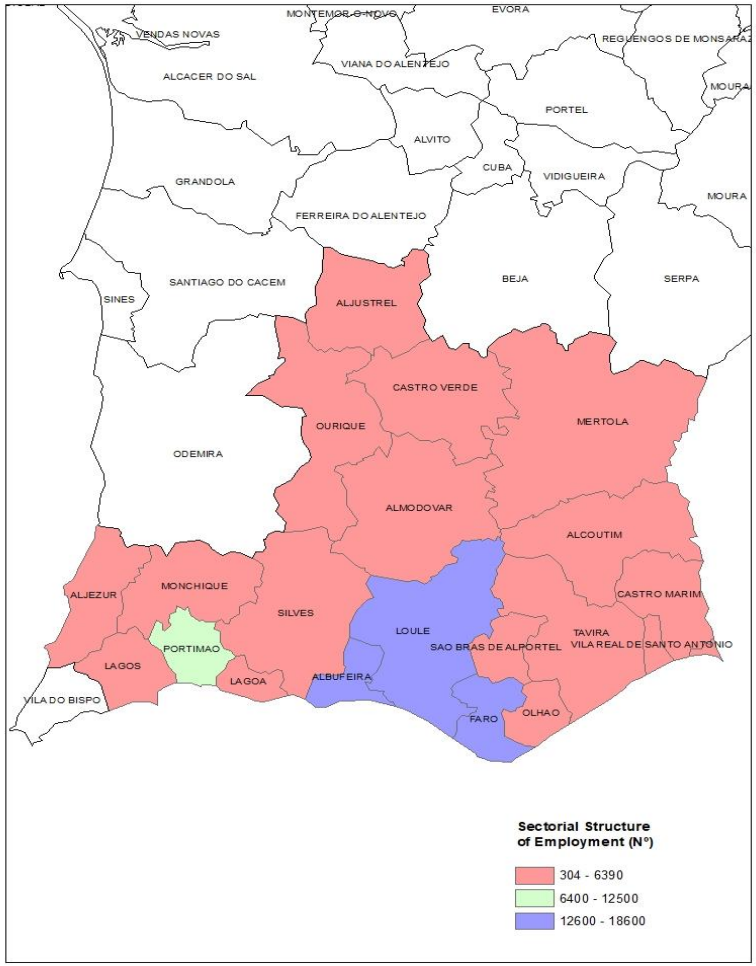

Figure AIII.6 – Sectorial Structure of Employment

Source: Own elaboration

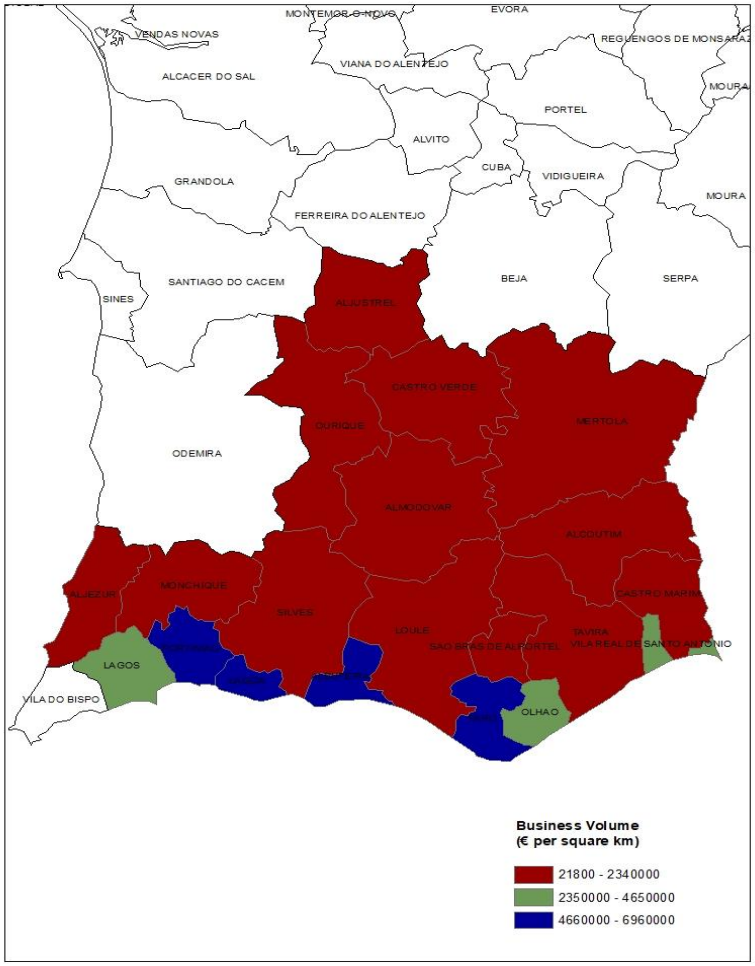

Figure AIII.7 – Business Volume

Source: Own elaboration

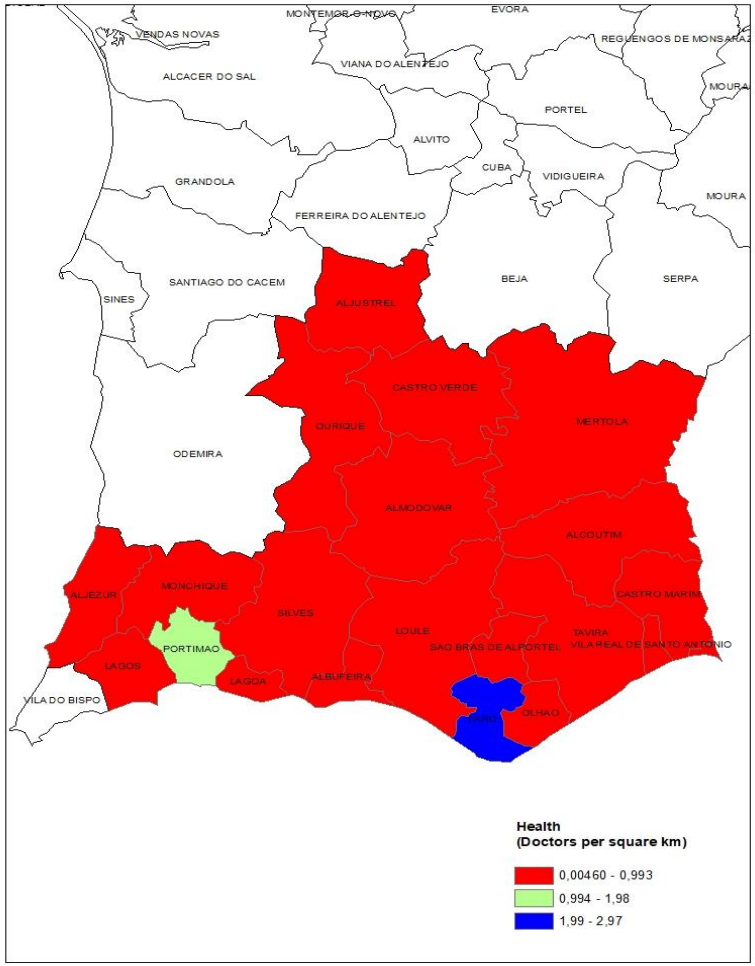

Figure AIII.8 – Health

Source: Own elaboration

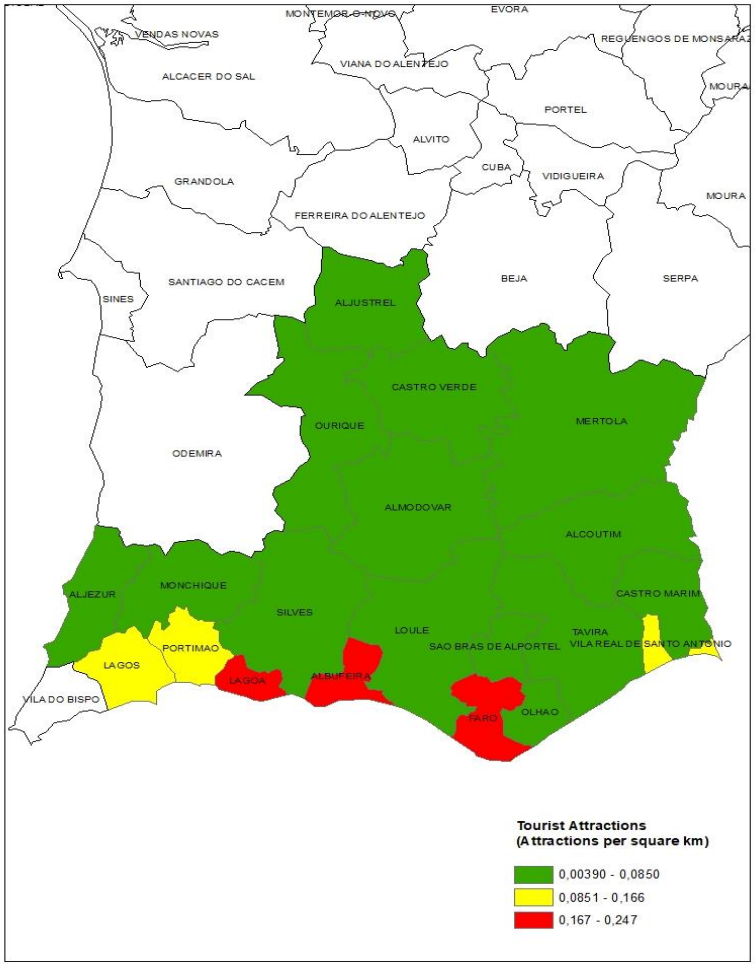

Figure AIII.9 – Tourist Attractions

Source: Own elaboration

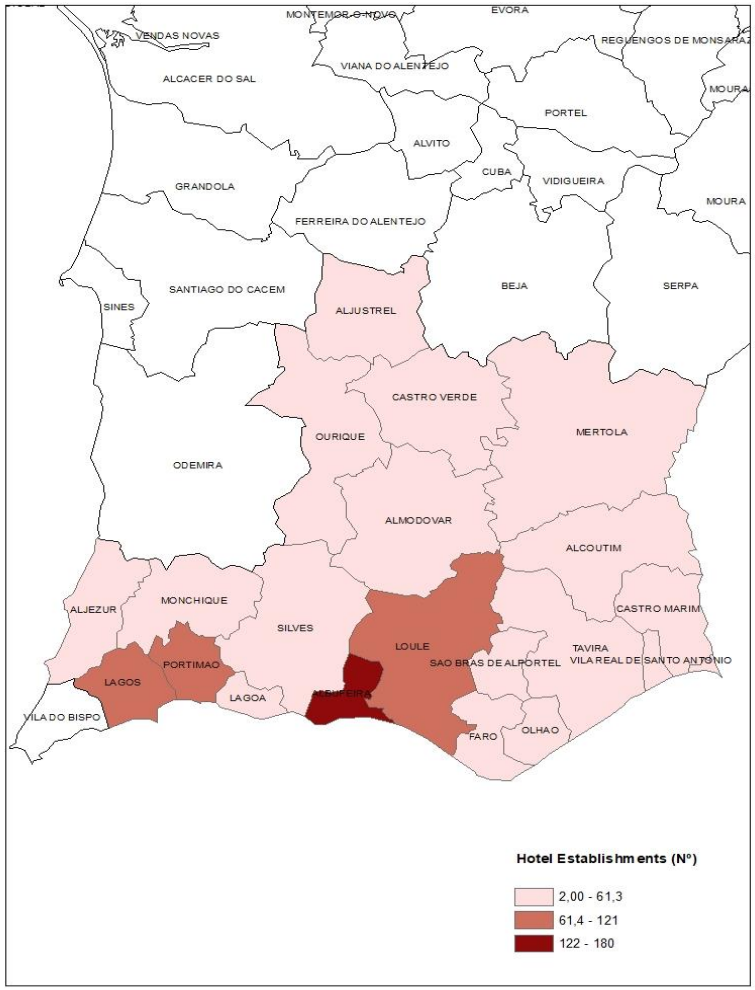

Figure AIII.10 – Hotel Establishments

Source: Own elaboration

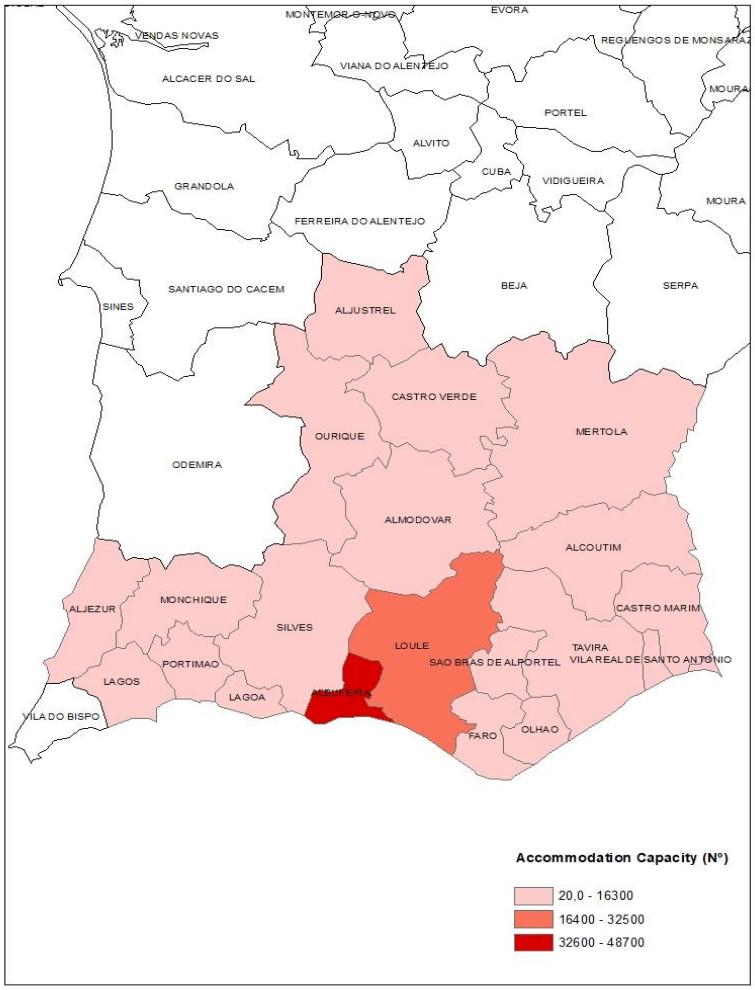

Figure AIII.11 – Accommodation Capacity

Source: Own elaboration

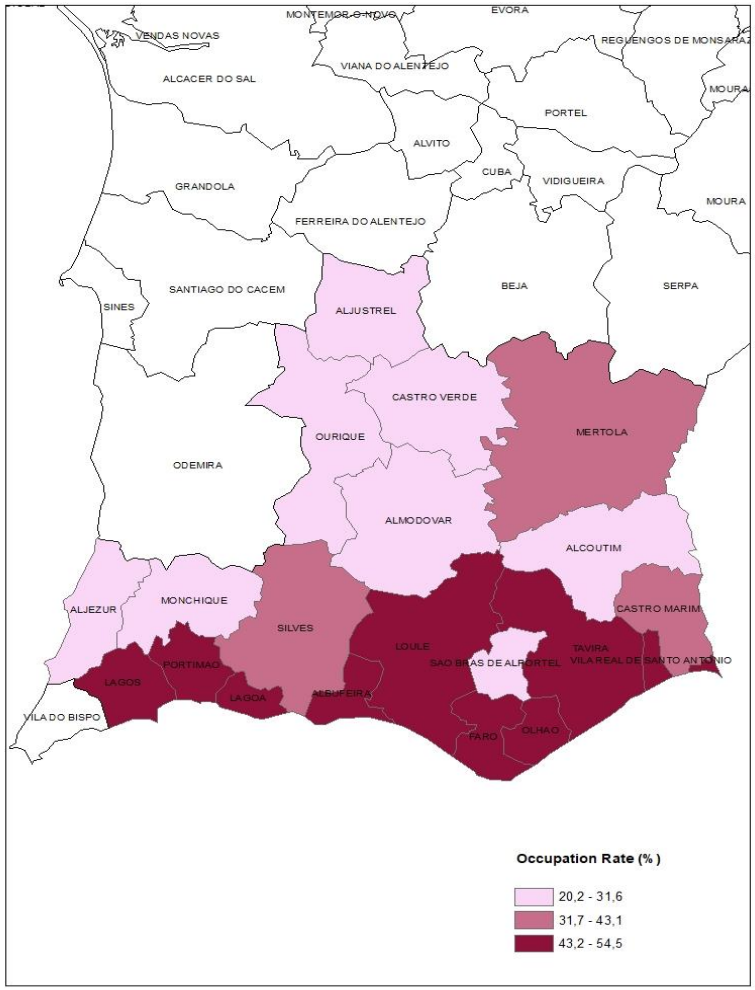

Figure AIII.12 – Occupation Rate

Source: Own elaboration

IV – Evolution 2001-2011

This chapter presents the evolution of the socioeconomic indicators from 2001 to 2011.

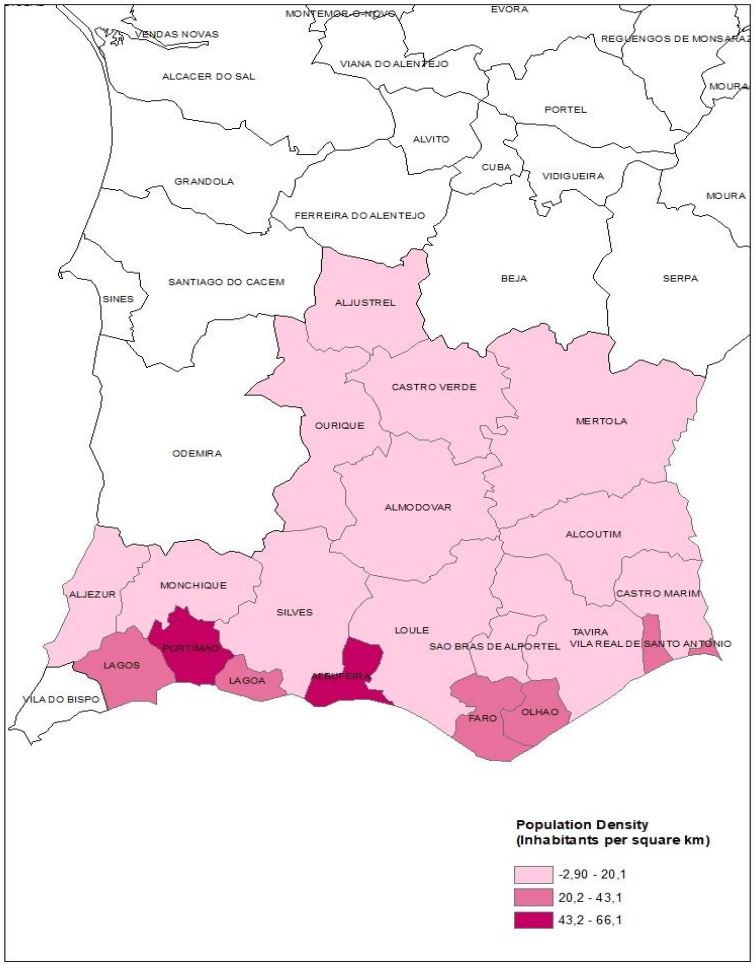

Figure AIV.1 – Population Density

Source: Own elaboration

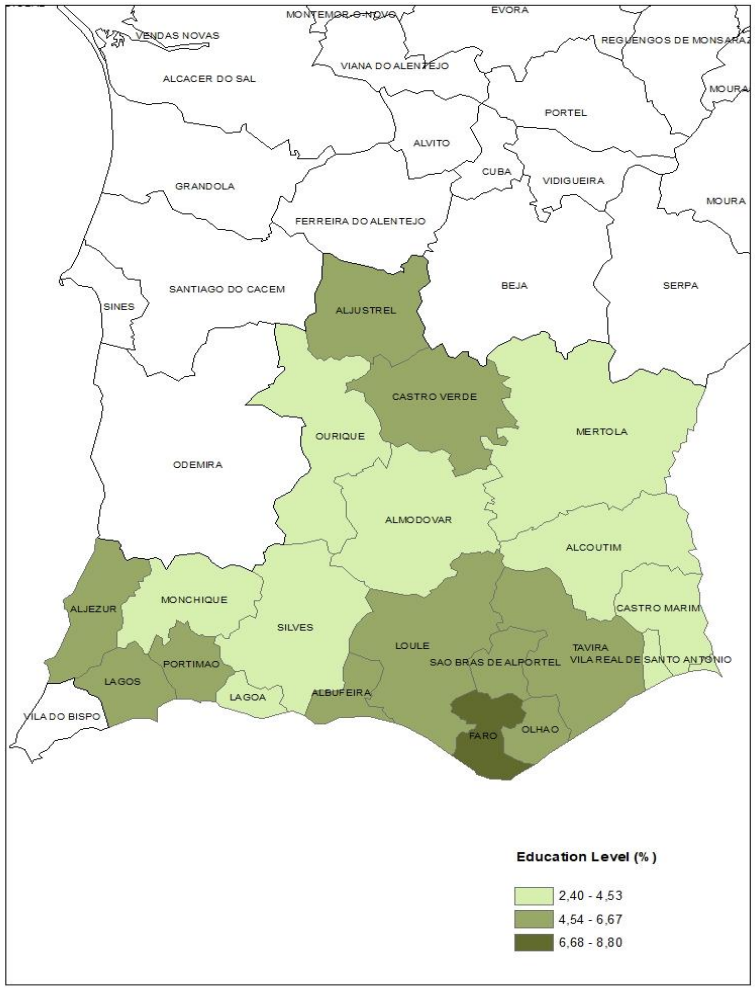

Figure AIV.2 – Education Level

Source: Own elaboration

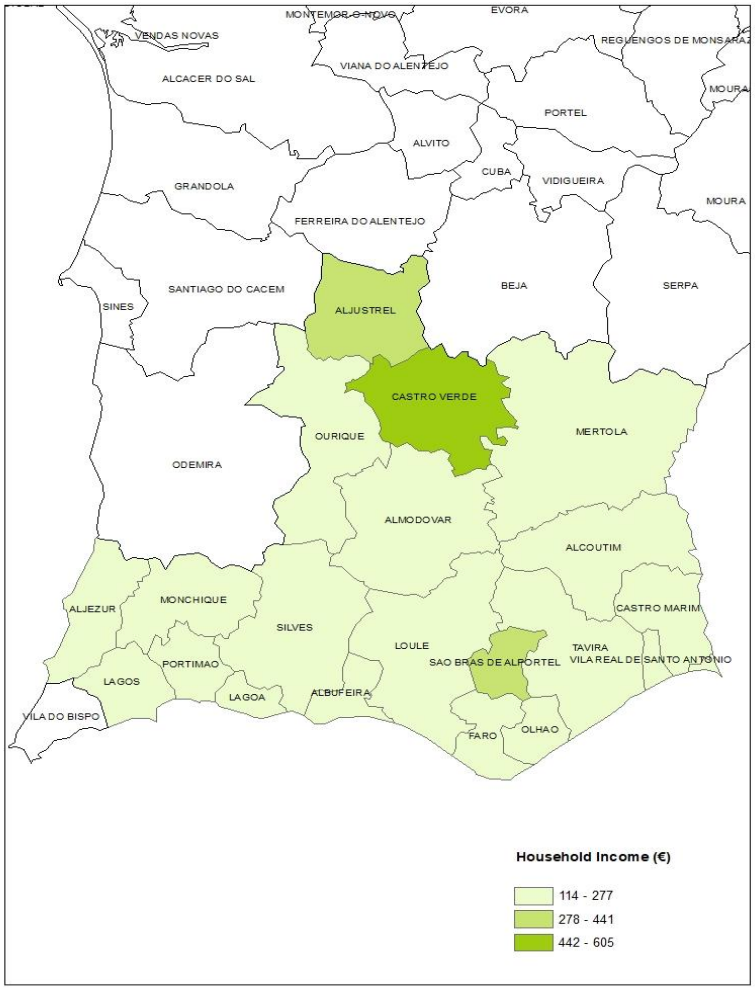

Figure AIV.3 – Household Income

Source: Own elaboration

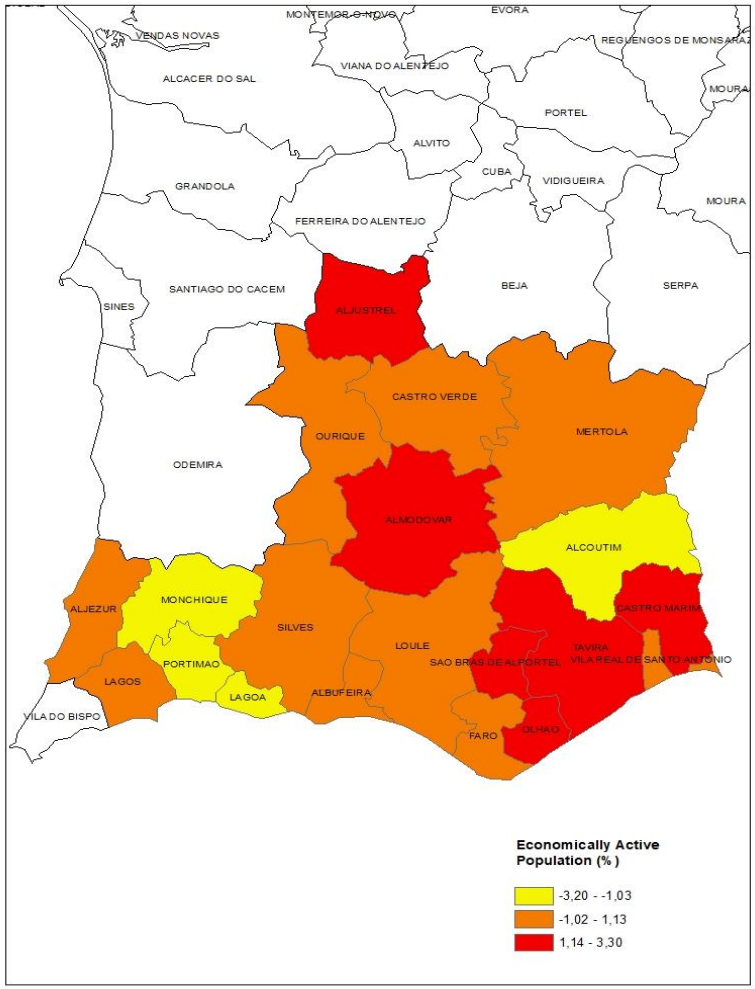

Figure AIV.4 – Economically Active Population

Source: Own elaboration

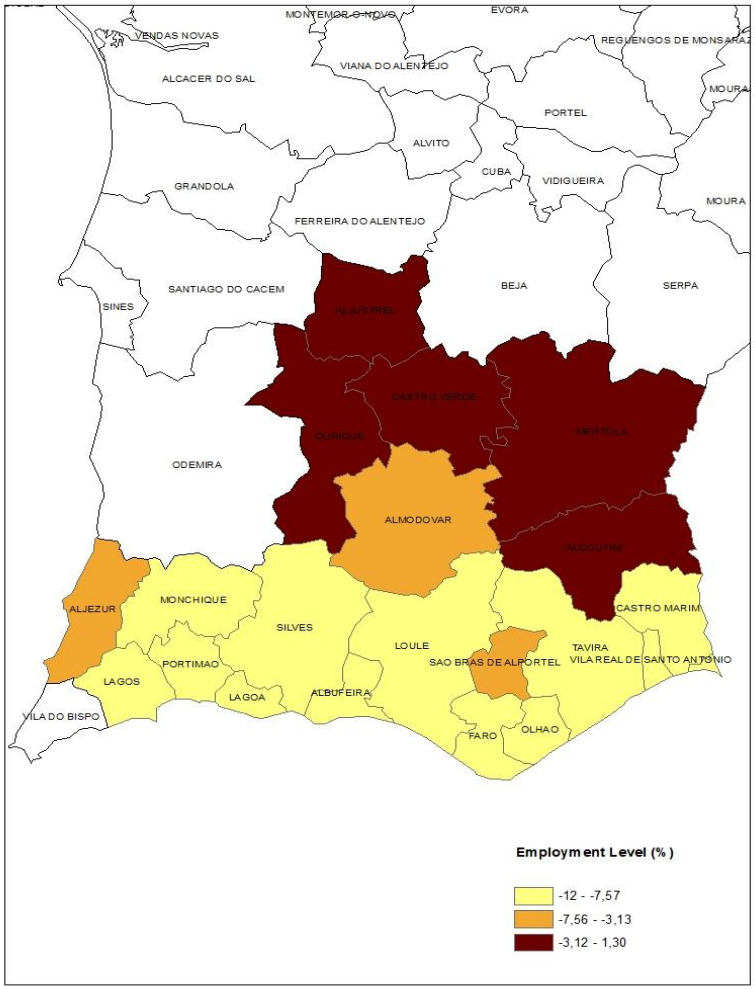

Figure AIV.5 – Employment Level

Source: Own elaboration

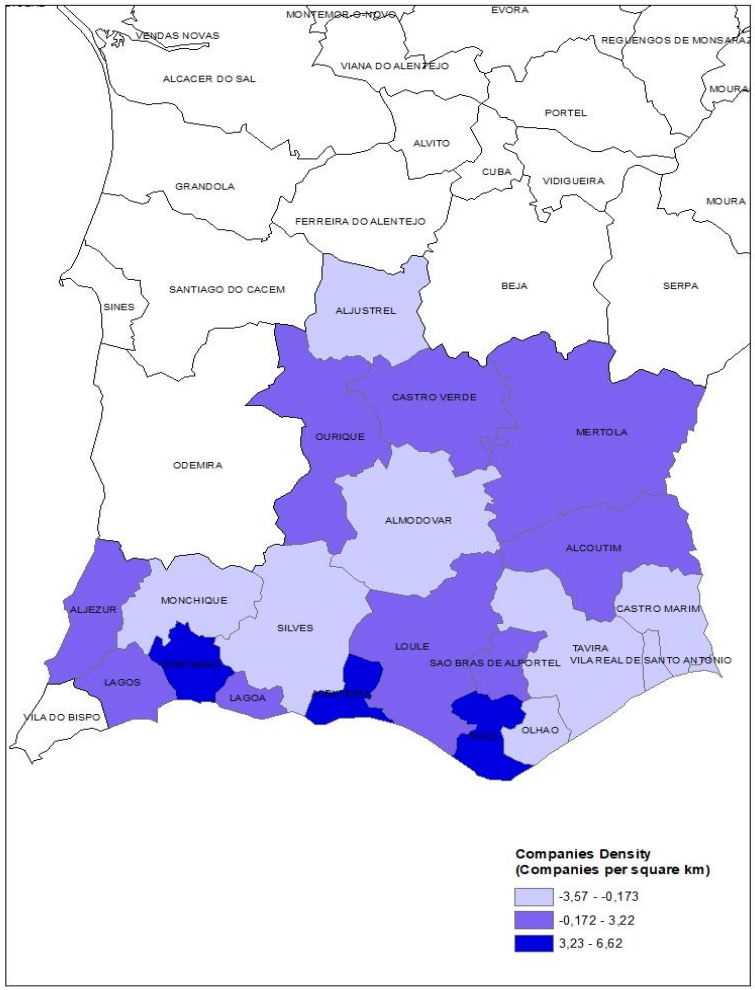

Figure AIV.6 – Companies Density

Source: Own elaboration

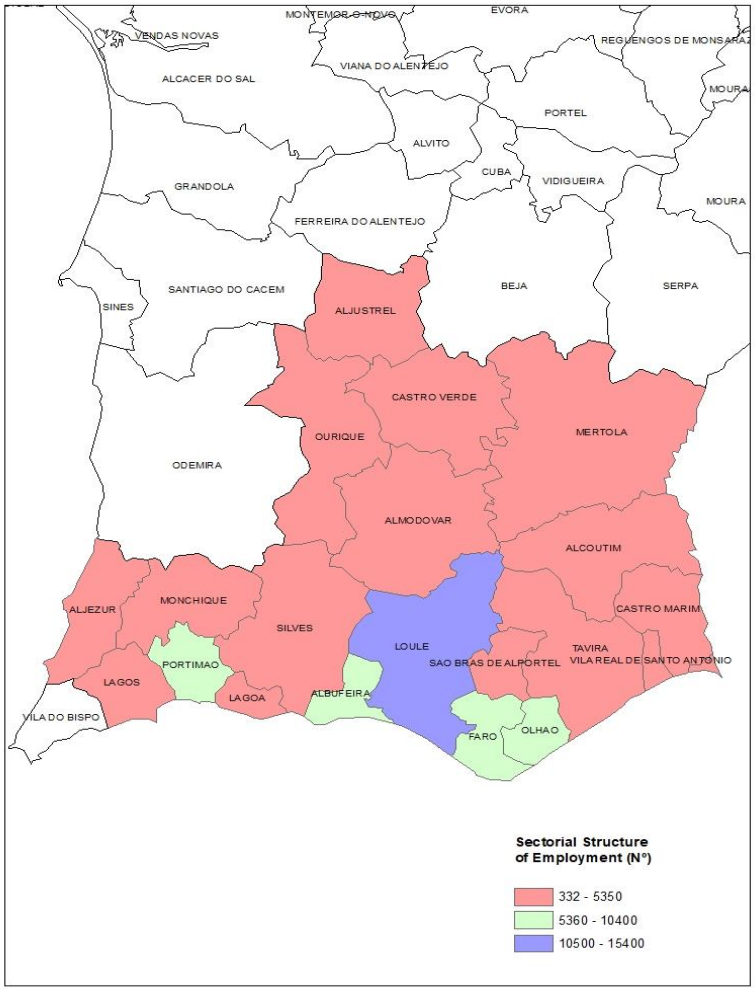

Figure AIV.7 – Sectorial Structure of Employment

Source: Own elaboration

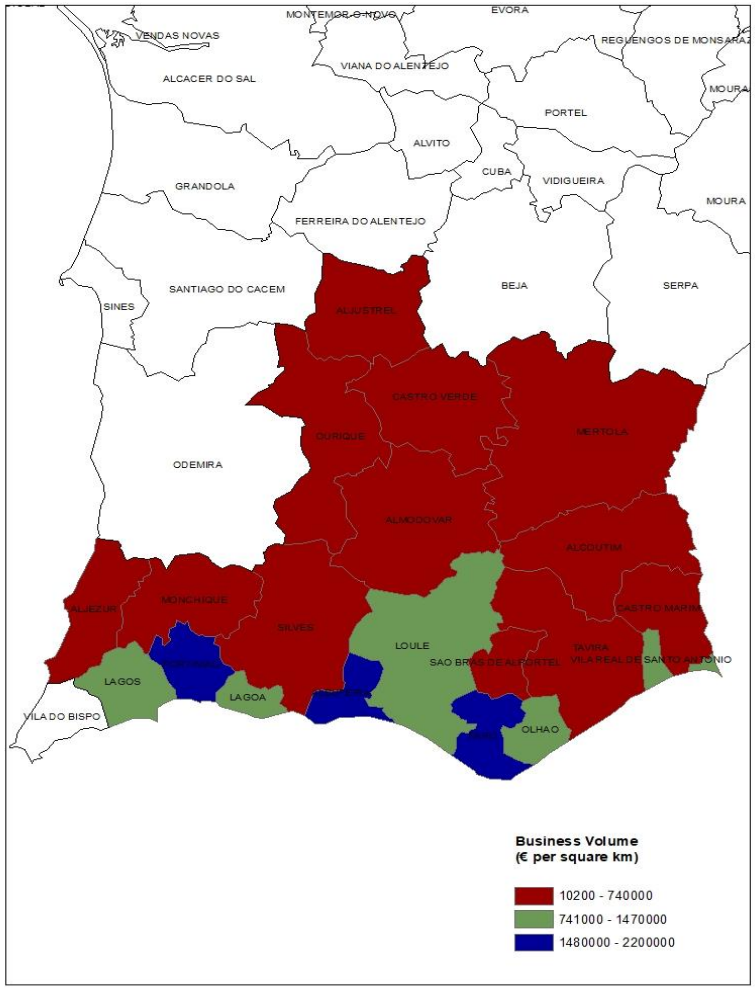

Figure AIV.8 – Business Volume

Source: Own elaboration

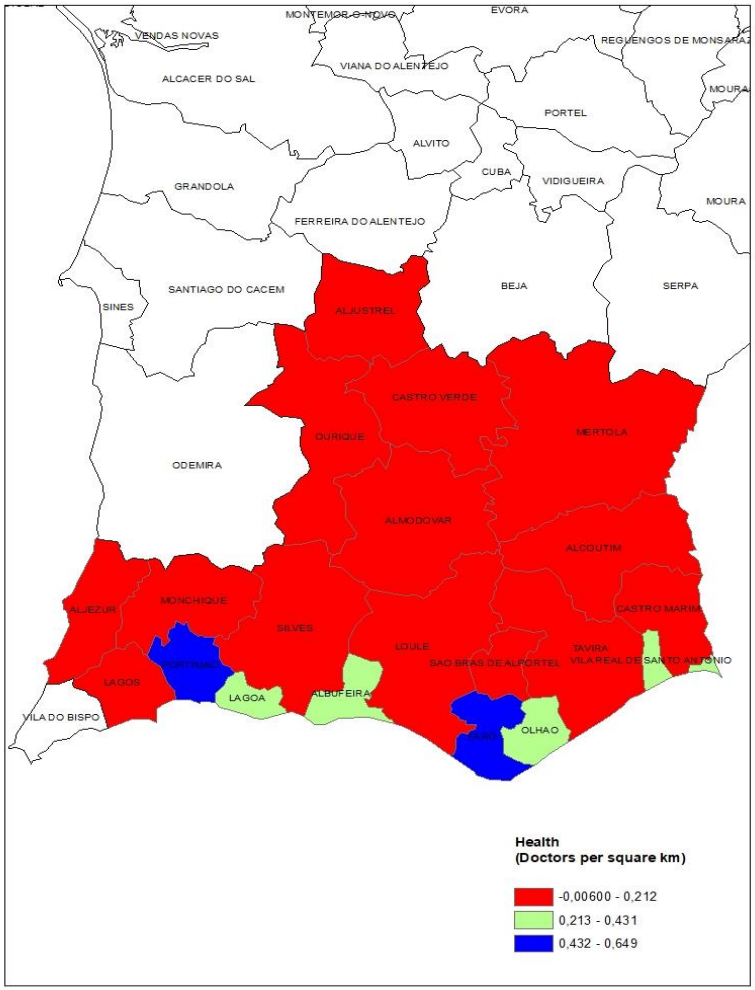

Figure AIV.9 – Health

Source: Own elaboration

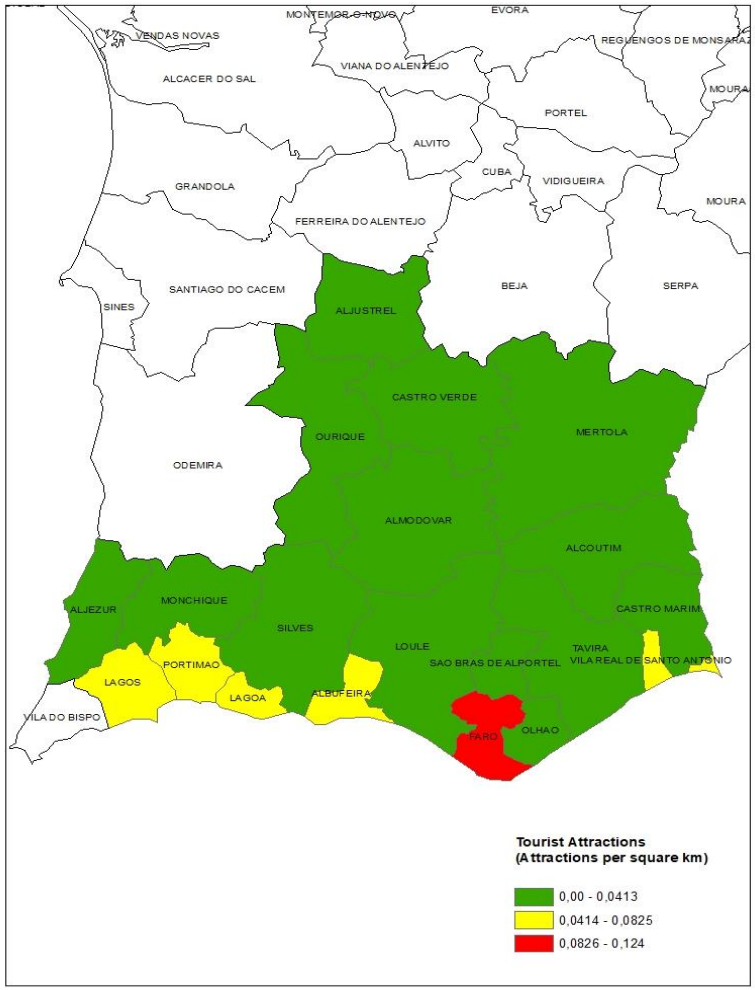

Figure AIV.10 – Tourist Attractions

Source: Own elaboration

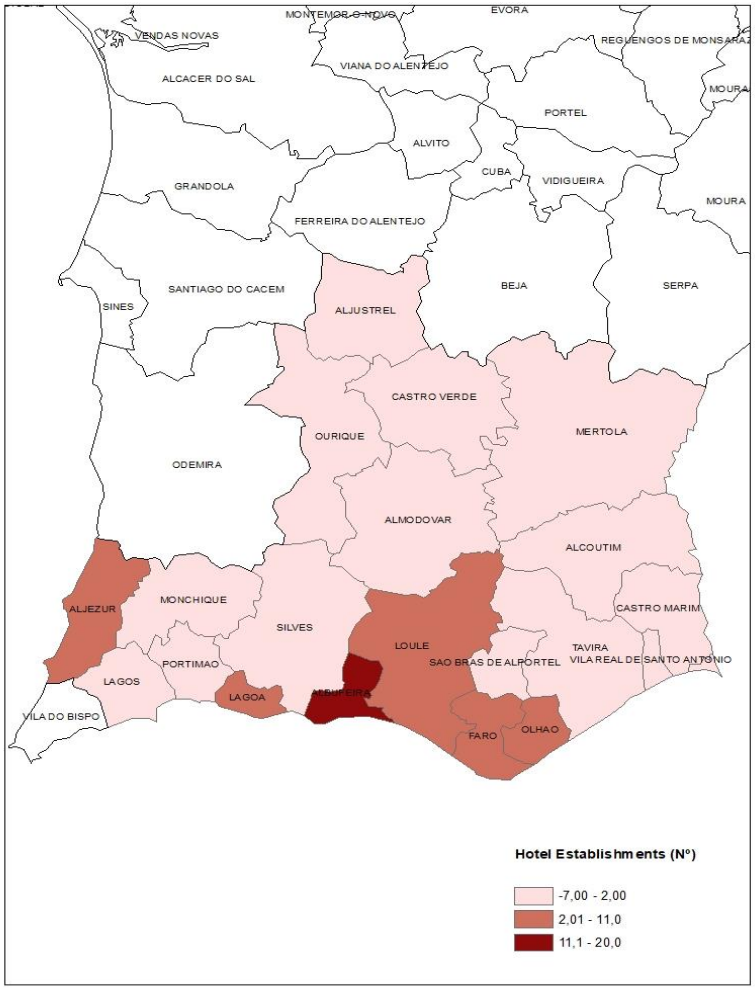

Figure AIV.11 – Hotel Establishments

Source: Own elaboration

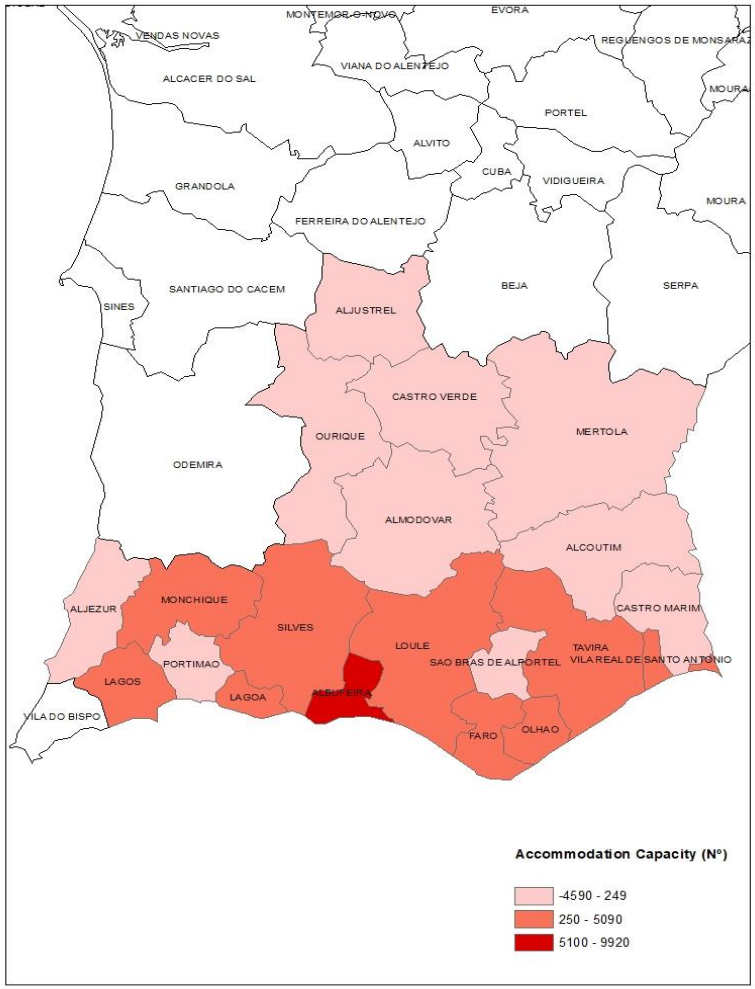

Figure AIV.12 – Accommodation Capacity

Source: Own elaboration

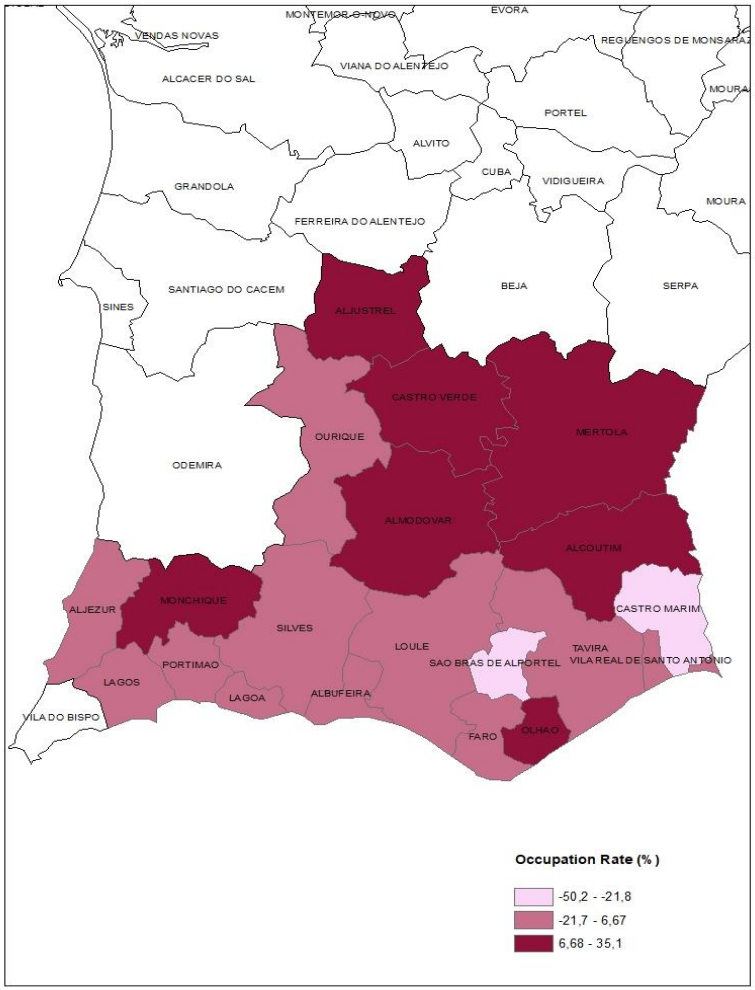

Figure AIV.13 – Occupation Rate

Source: Own elaboration

V – Evolution 2001-2016

This chapter includes the evolution of the socioeconomic indicators from 2001 to 2016.

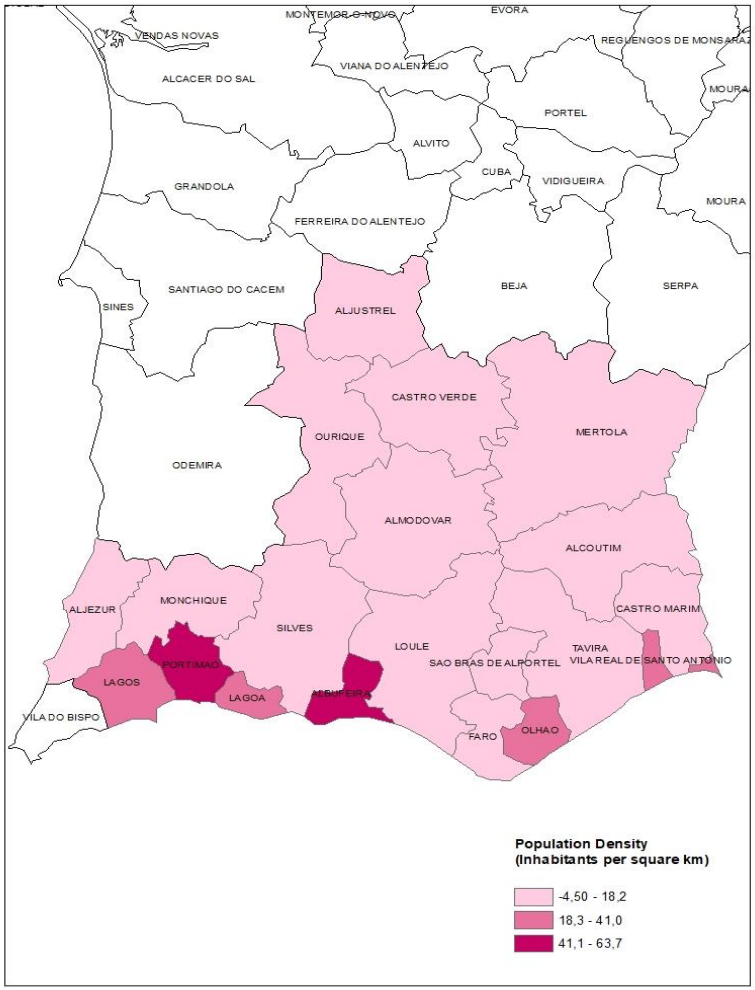

Figure AV.1 – Population Density

Source: Own elaboration

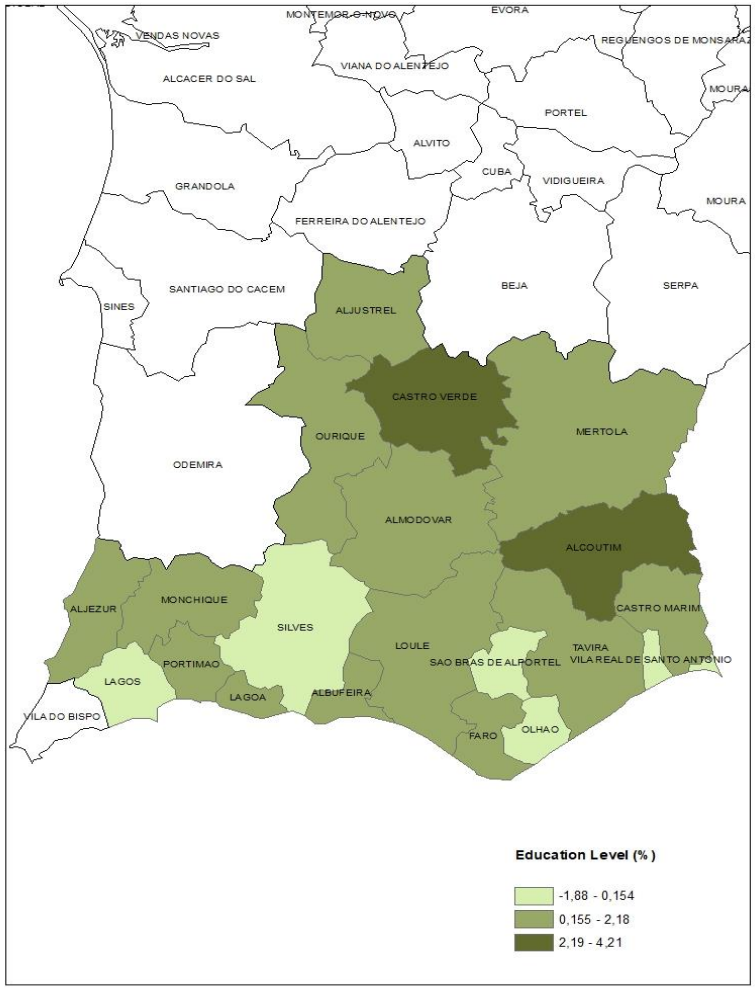

Figure AV.2 – Education Level

Source: Own elaboration

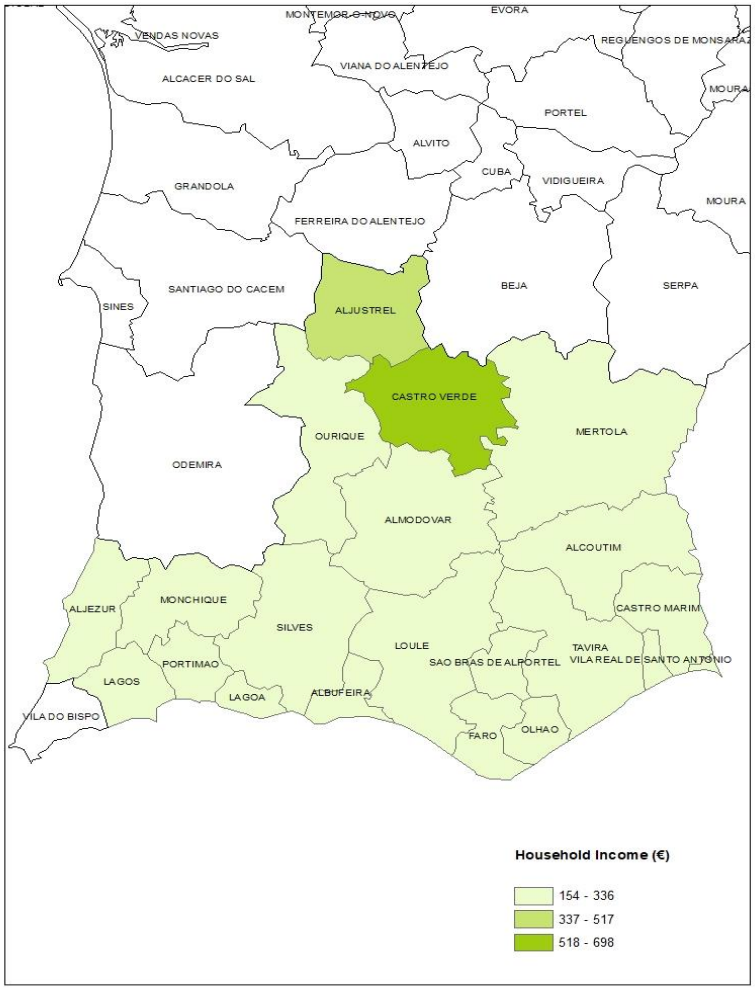

Figure AV.3 – Household Income

Source: Own elaboration

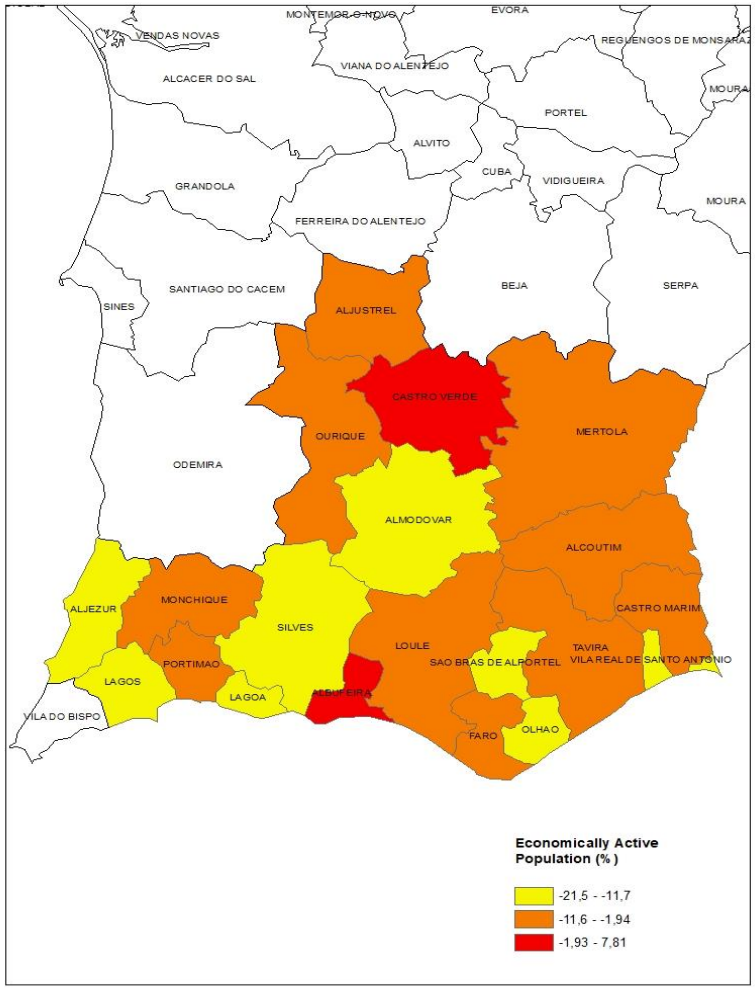

Figure AV.4 – Economically Active Population

Source: Own elaboration

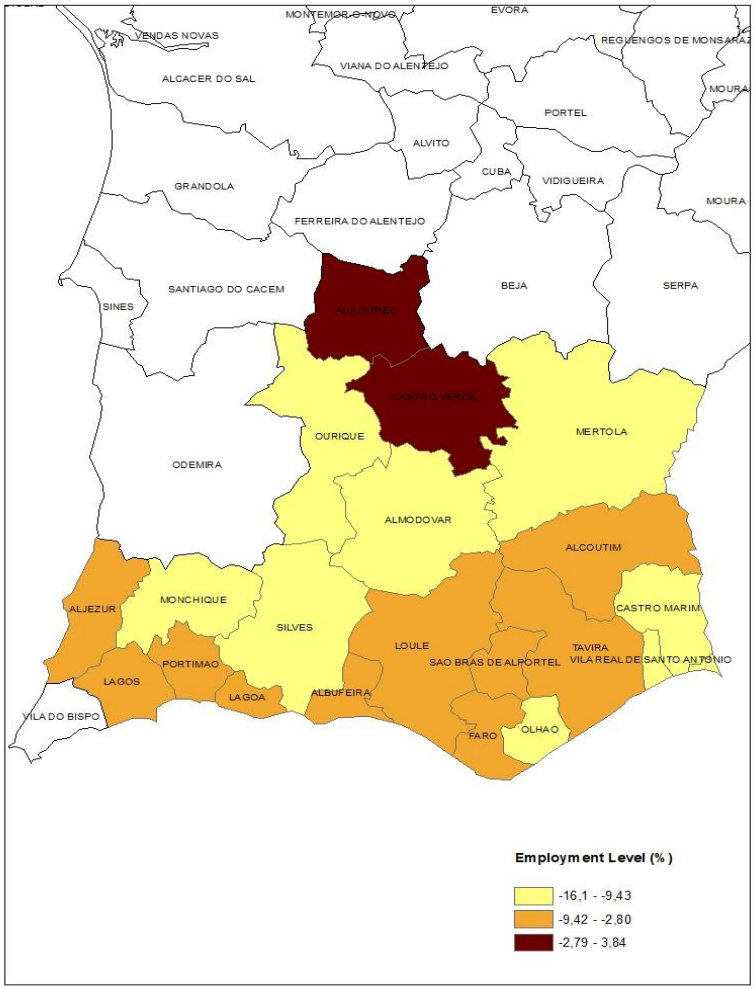

Figure AV.5 – Employment Level

Source: Own elaboration

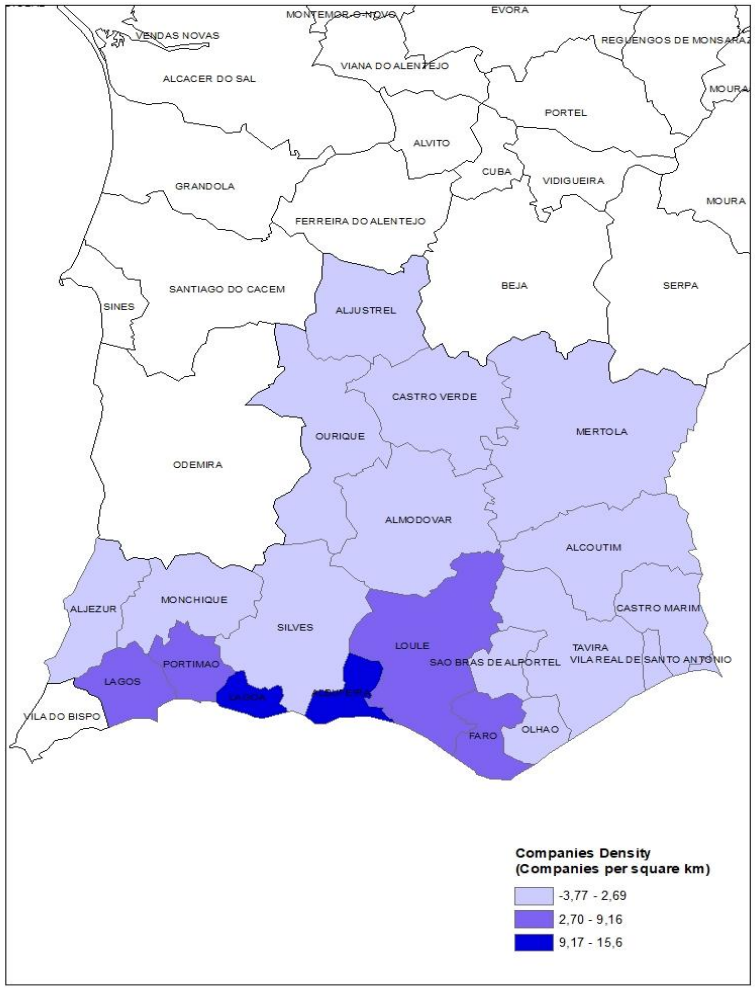

Figure AV.6 – Companies Density

Source: Own elaboration

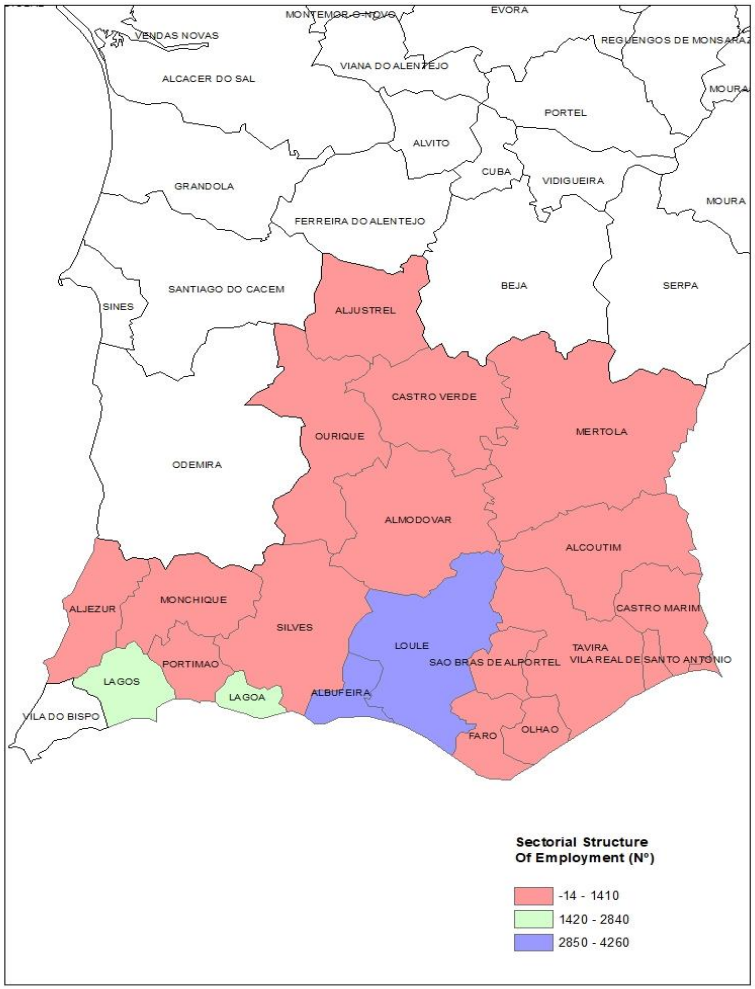

Figure AV.7 – Sectorial Structure of Employment

Source: Own elaboration

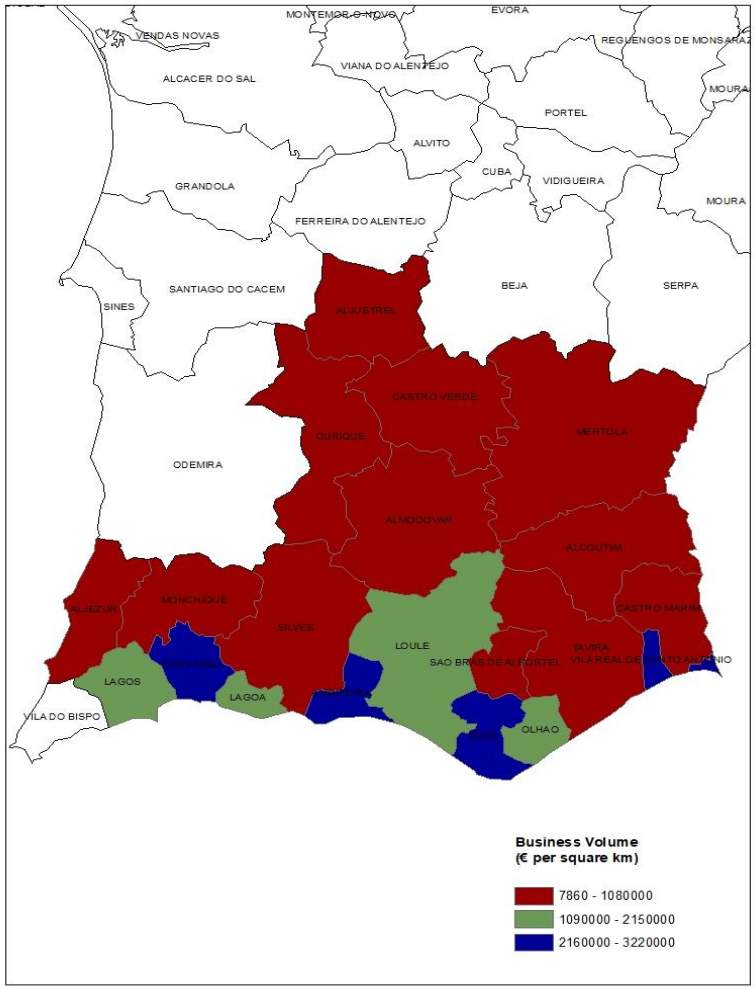

Figure AV.8 – Business Volume

Source: Own elaboration

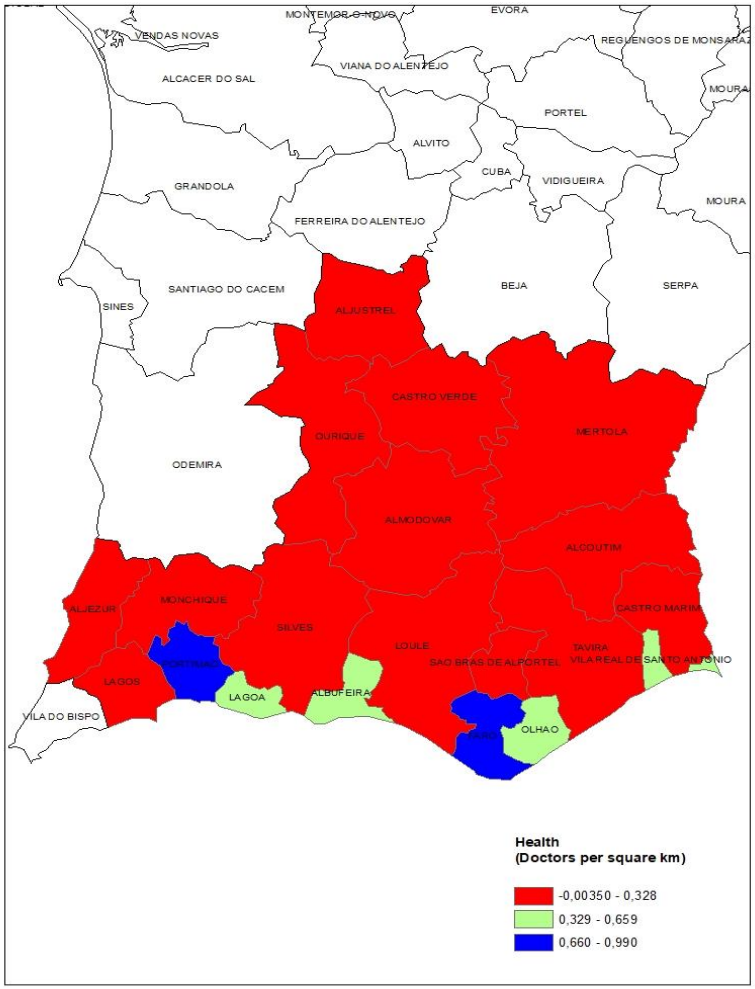

Figure AV.9 – Health

Source: Own elaboration

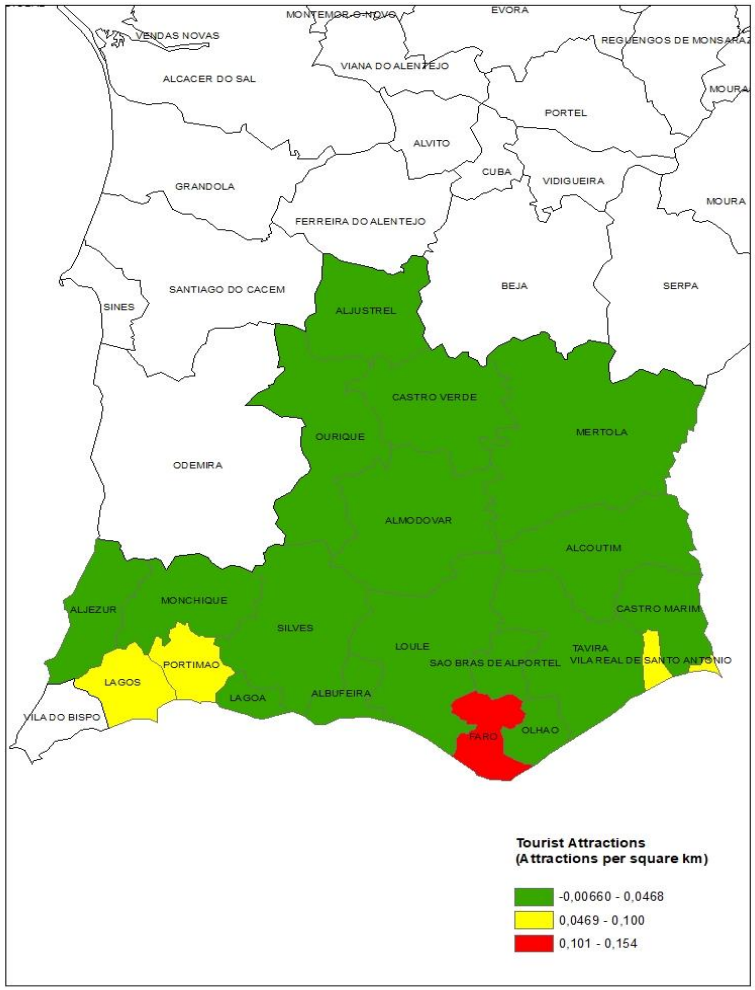

Figure AV.10 – Tourist Attractions

Source: Own elaboration

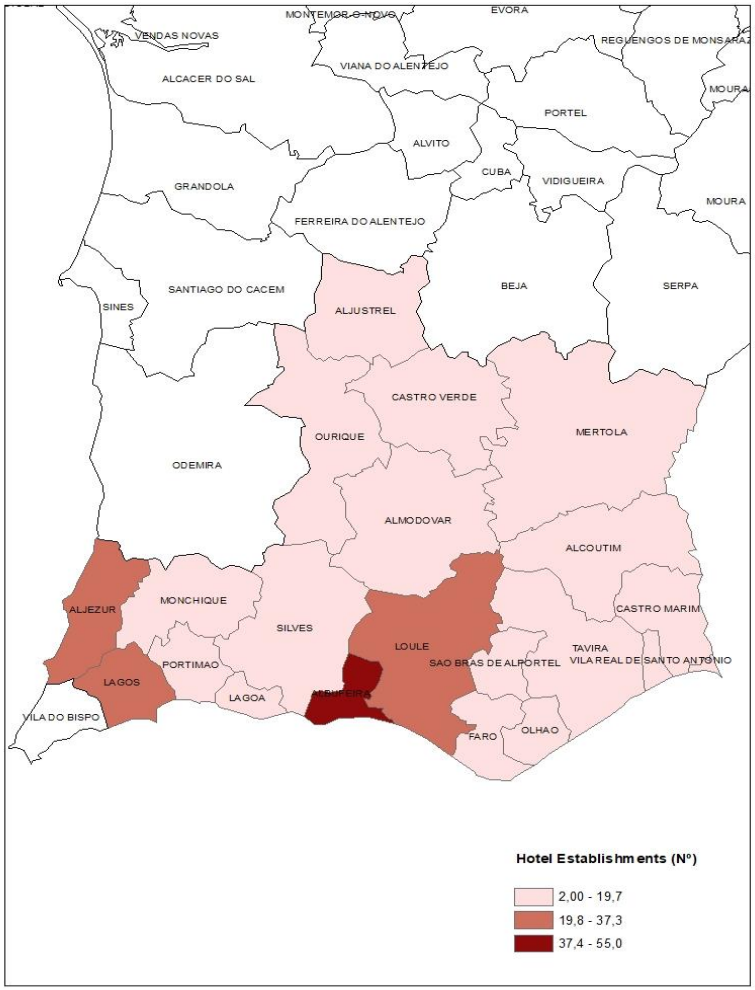

Figure AV.11 – Hotel Establishments

Source: Own elaboration

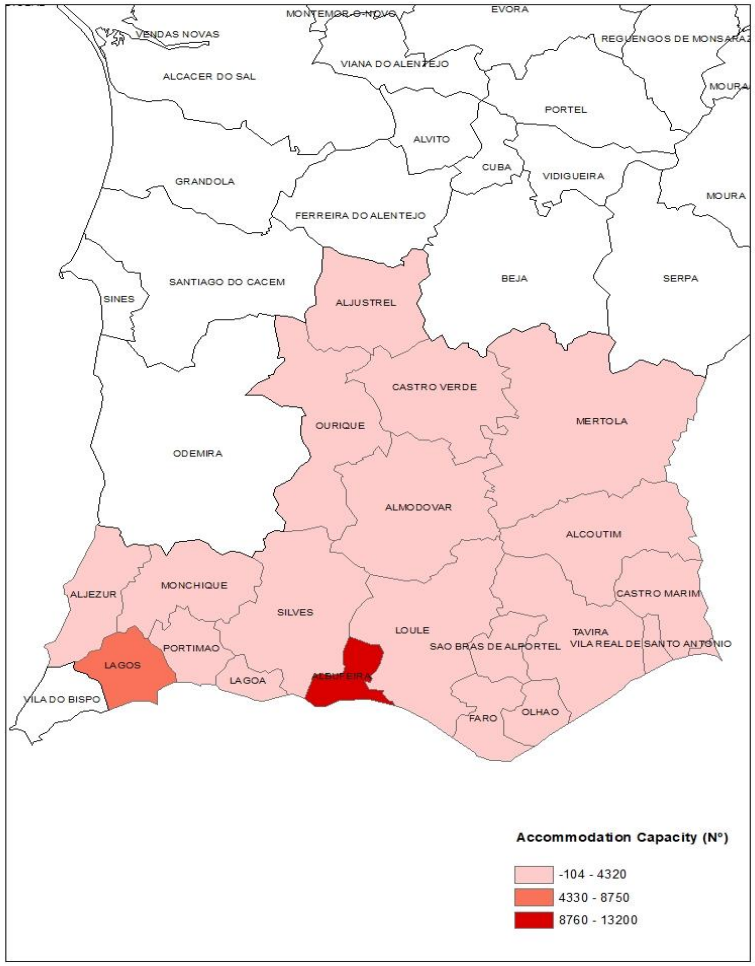

Figure AV.12 – Accommodation Capacity

Source: Own elaboration

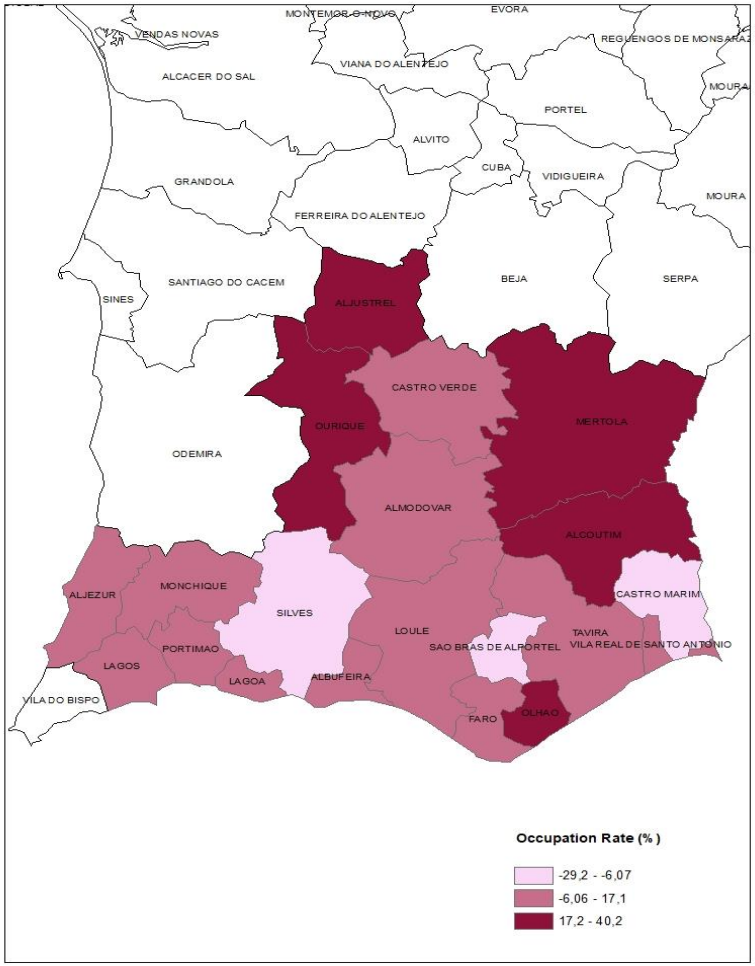

Figure AV.13 – Occupation Rate

Source: Own elaboration

VI – Evolution 2011-2016

This chapter includes the evolution of the socioeconomic indicators from 2011 to 2016.

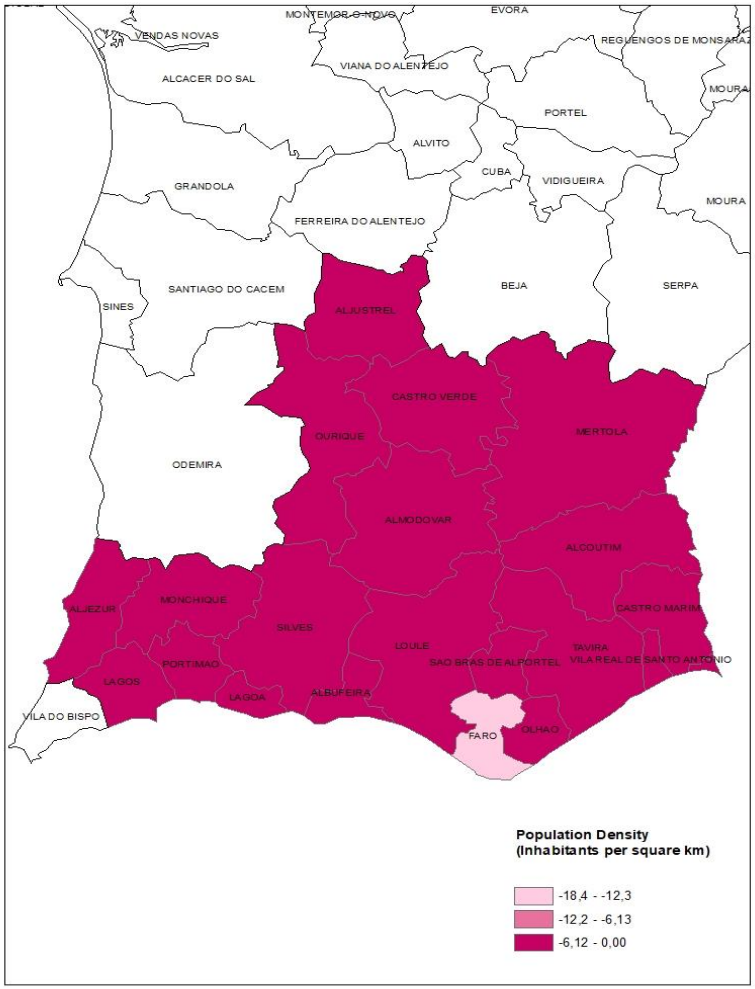

Figure AVI.1 – Population Density

Source: Own elaboration

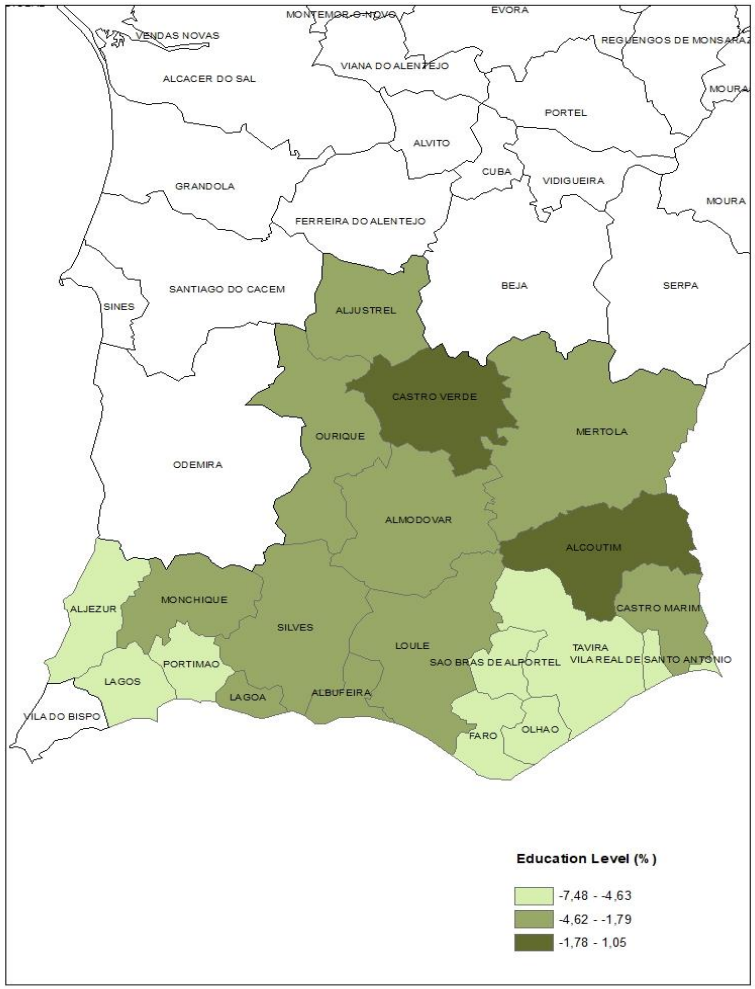

Figure AVI.2 – Education Level

Source: Own elaboration

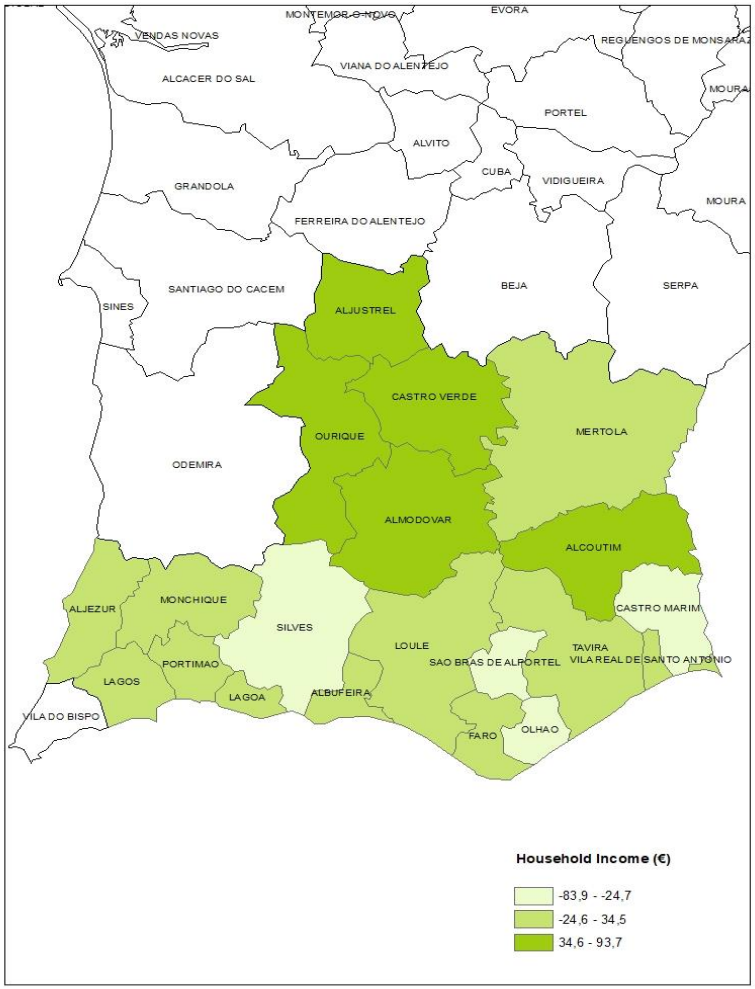

Figure AVI.3 – Household Income

Source: Own elaboration

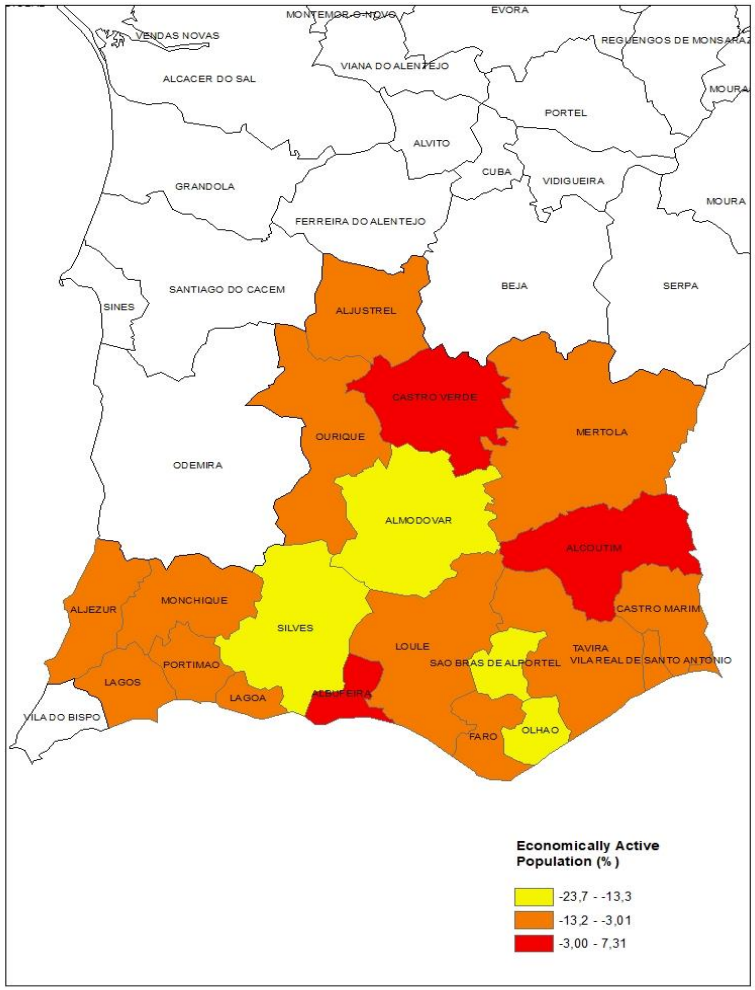

Figure AVI.4 – Economically Active Population

Source: Own elaboration

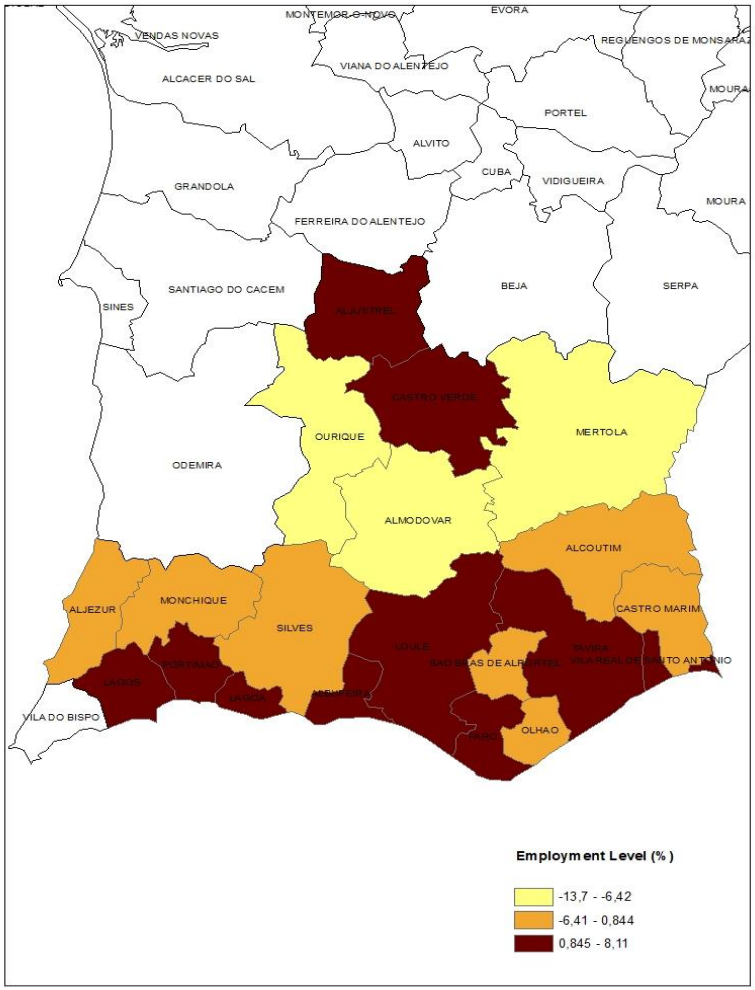

Figure AVI.5 – Employment Level

Source: Own elaboration

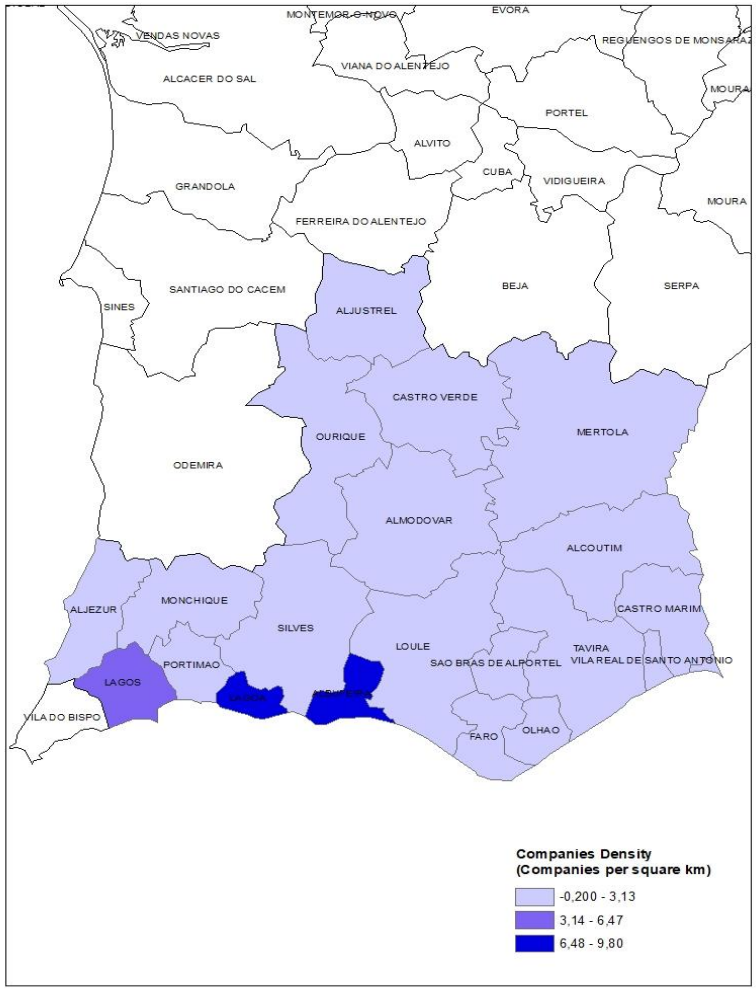

Figure AVI.6 – Companies Density

Source: Own elaboration

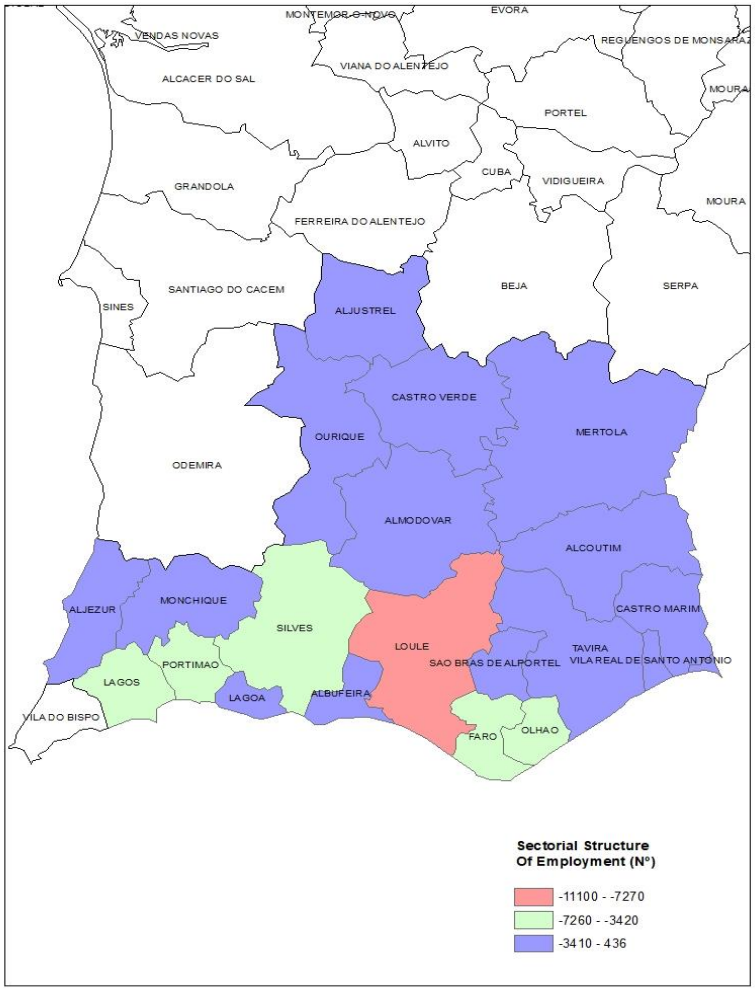

Figure AVI.7 – Sectorial Structure of Employment

Source: Own elaboration

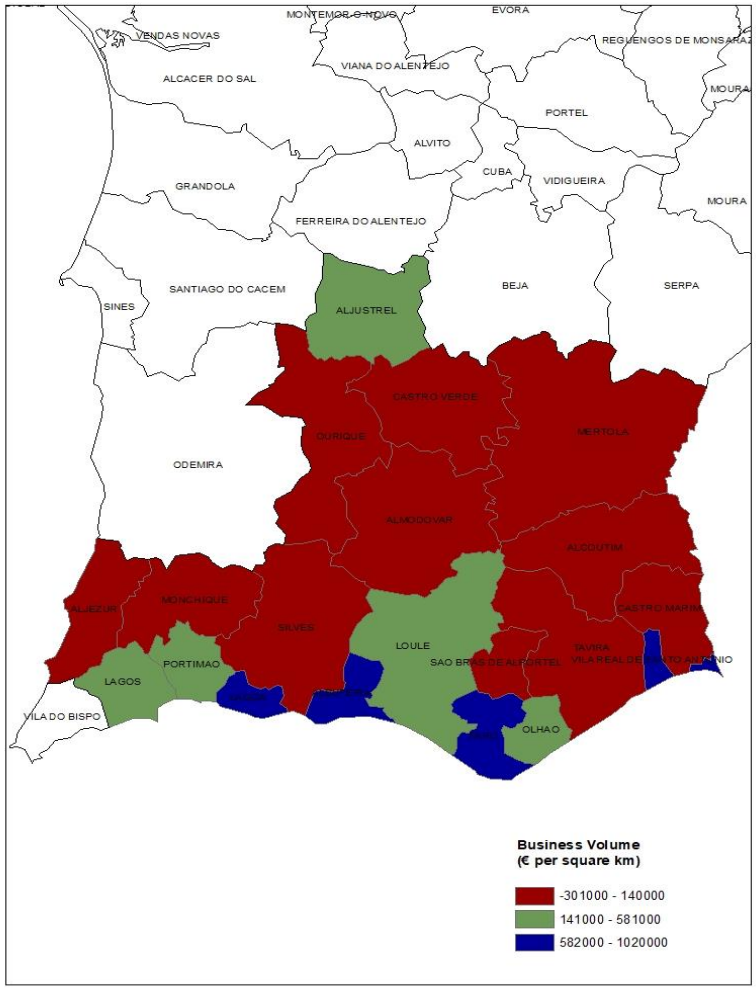

Figure AVI.8 – Business Volume

Source: Own elaboration

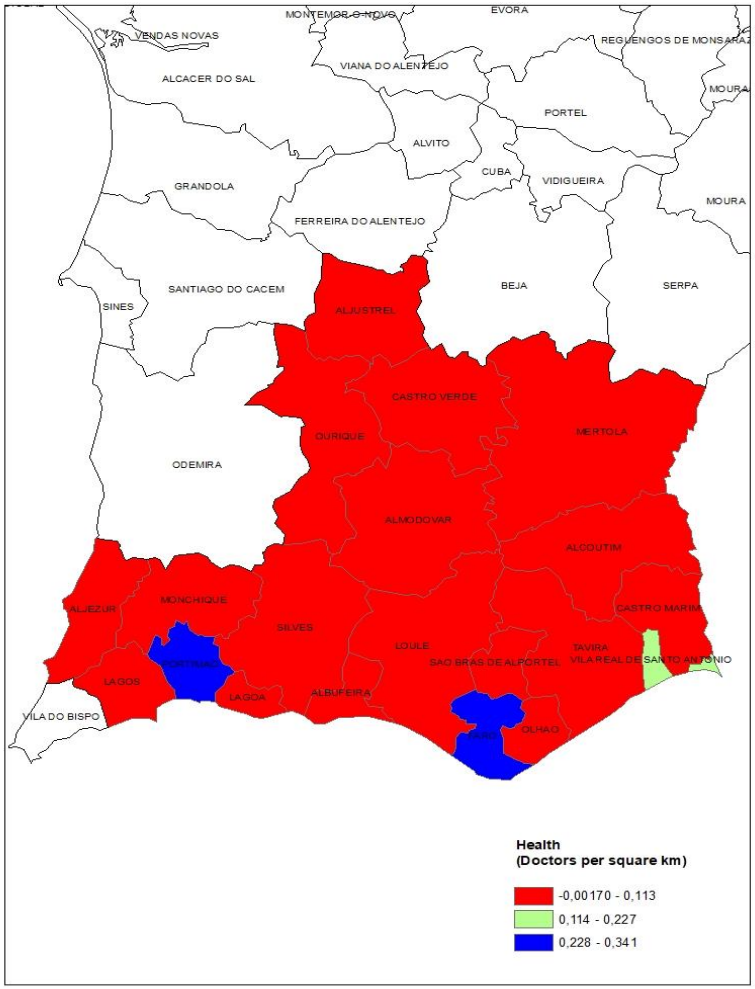

Figure AVI.9 – Health

Source: Own elaboration

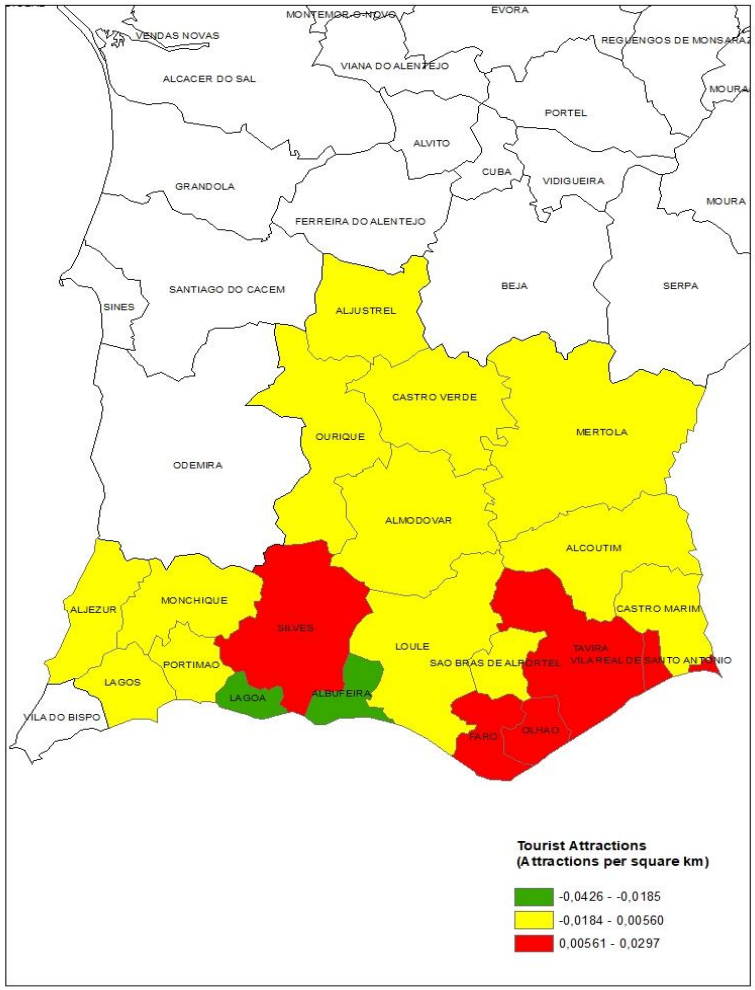

Figure AVI.10 – Tourist Attractions

Source: Own elaboration

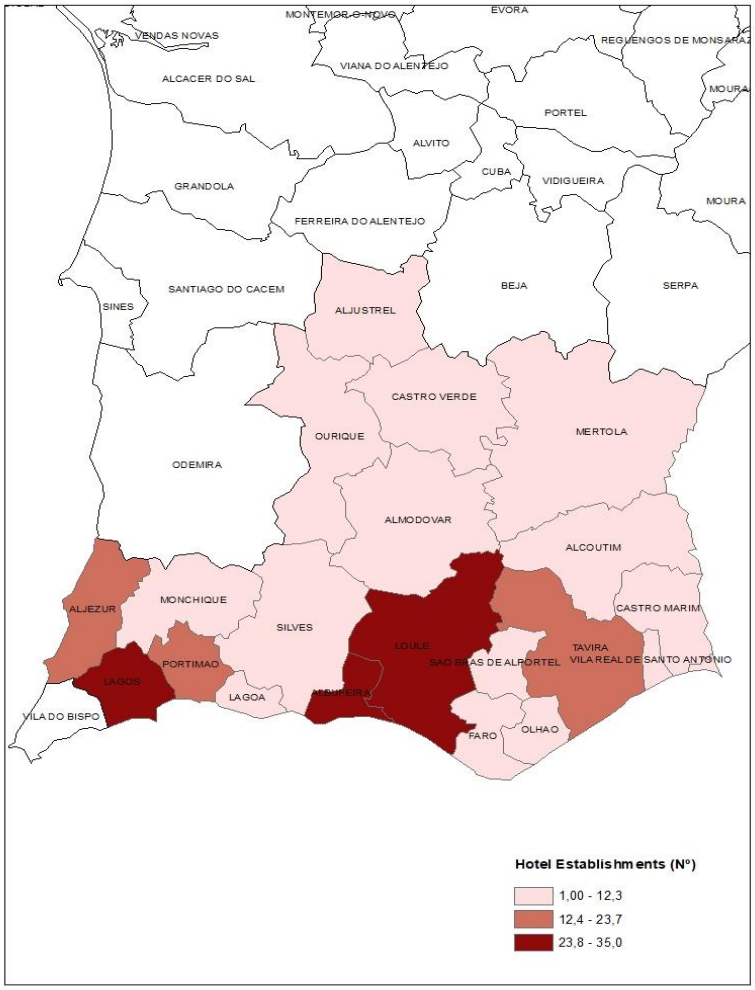

Figure AVI.11 – Hotel Establishments

Source: Own elaboration

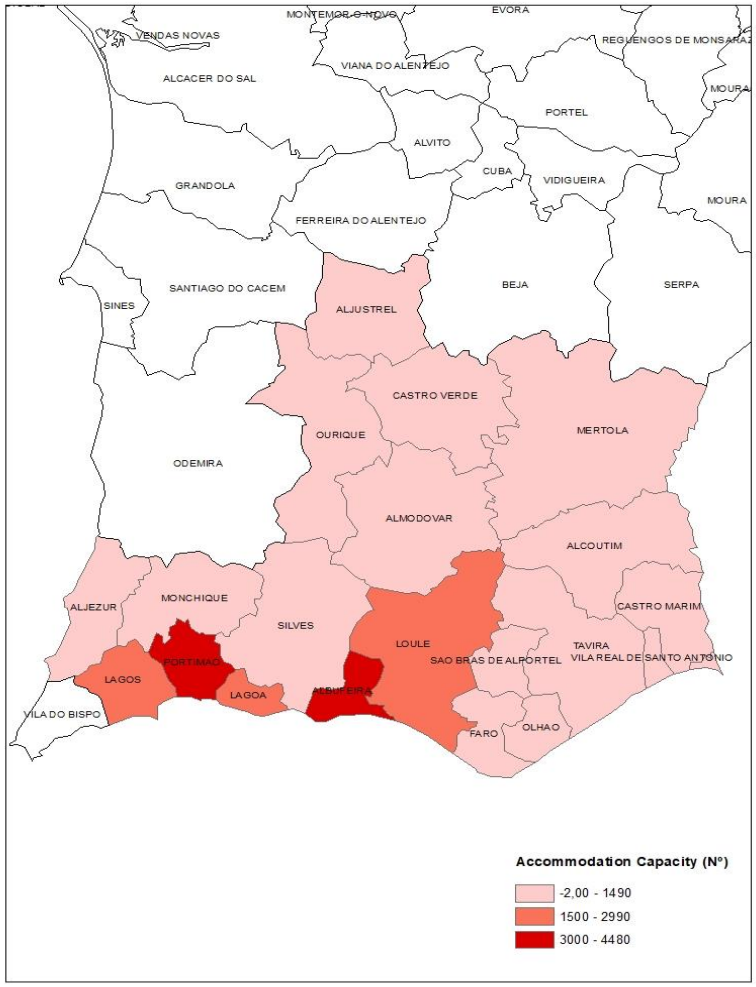

Figure AVI.12 – Accommodation Capacity

Source: Own elaboration

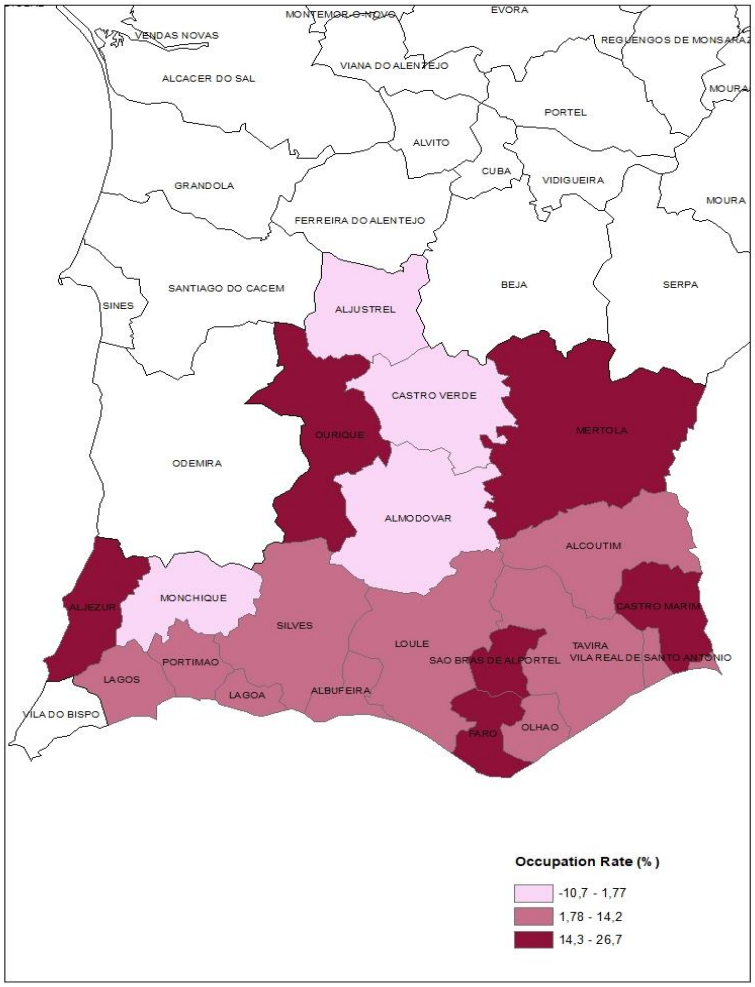

Figure AVI.13 – Occupation Rate

Source: Own elaboration

Annexe 2

Publication Abstract accepted for VII Ridita

The concept of Aerotropolis applied to a medium-sized city and its airport. The case of Faro in the south of Portugal.

João Carmo, Maria E. Baltazar, Jorge Silva

Abstract

Movements in Faro airport have been on a constant rise even exceeding the airport capacity. Faro city has grown in the same proportion. Both occurred in a pattern that can be applied to compare with the development of an Aerotropolis.

At least three steps must be taken to develop an effective Aerotropolis plan. First, the catchment area is determined based on the existing transportation network and 60-minute travel time from the airport. Second, several socioeconomic indicators within the catchment area are evaluated through different periods using GIS software. Third, catchment area and socioeconomic indicators for the Faro region are compared with layouts obtained from several examples of Aerotropolises in Europe.

The Aerotropolis model created by John Kasarda has been used in several regions across Europe. One key aspect of this model is determining whether the region evolved along with the airport throughout the years. Faro, its airport and surrounding areas, are not an exception. Thus, it is possible to identify Faro development patterns of growth useful for several stakeholders: administrative authorities, airport authorities, and territory planners.

Faro airport movements have been on a constant rise. Faro city has grown, probably, in the same proportion. Both growths can be compared with an Aerotropolis development. Identifying development patterns of growth will be useful for: those responsible for the distribution of services in the territory; those who oversee the airport operation and expansion; those who are responsible for combining the interests of all for the regional development.

Keywords: Aerotropolis, Catchment Area, GIS, Airport.