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Como está o futuro a ser preparado pelas empresas de software em Portugal?

Health Pervasive Technologies

How is the future being prepared by software companies in Portugal?



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Tese apresentada à Universidade de Aveiro para cumprimento dos requisitos necessários à obtenção do grau de Doutor em Ciências e Tecnologias da Saúde, realizada sob a orientação científica do Doutor Nelson Rocha, Professor Diretor de curso do Programa Doutoral em Ciências e Tecnologias da Saúde do Departamento de Ciências Médicas da Universidade de Aveiro.

Dedico este trabalho ao meu pai, minha mãe, minha esposa e minha filha.

o júri

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palavras-chave

Software, cuidados de saúde, produtores, exportações, mercado, cluster, smartphone.

resumo

O presente trabalho aborda a indústria do software pretendendo avaliar a sua preparação para a oportunidade que a área da saúde oferece em termos de tecnologias pervasivas de saúde numa perspetiva de crescimento do mercado. Fenómenos como o aumento das doenças crónicas, a crescente longevidade, bem como o aparecimento de soluções tecnológicas extraordinariamente sofisticadas, oferece oportunidades de crescimento à indústria do software e indicam um caminho por onde as sociedades estão a orientar-se e a dar especial importância. Após uma pesquisa bibliográfica, que permitiu um levantamento das tecnologias atuais e da evolução das indústrias bem-sucedidas em Portugal, desenvolveu-se uma análise à indústria do software a partir dos resultados de um inquérito dirigido aos associados de uma Associação representativa da indústria. Do estudo conclui-se que embora haja aspetos positivos que poderão ajudar a indústria do software a preparar-se para as oportunidades que o sector da saúde oferece, há elementos essenciais que terão que ser melhorados não só na orgânica produtiva com base em clusters, mas também no conhecimento da área da saúde e enfoque nas exportações que terão que ser melhoradas para que a indústria possa ser bem-sucedida neste ramo.

keywords

Software, healthcare, producers, exportations, market, cluster, smartphone.

abstract

The present work addresses the software industry aiming to evaluate its preparation for the opportunity that the healthcare area offers in terms of pervasive healthcare technologies, as a perspective for the growth of the market. Phenomena such as chronic disease growth and survival, increasing longevity, active ageing, remote patient monitoring, the big data of healthcare and the globalization of the smartphone, provide growth opportunities for the software industry and indicate a path by which where societies are orienting themselves and giving special importance. Following a literature review, after a general introduction to the major themes of economic development and globalization, and a survey of current technologies and the evolution of successful industries in Portugal, it was developed an analysis to the software industry and the results of a survey of associates of an Industry Association. The study concludes that while there are positive aspects that may help the software industry to be prepared for the opportunities that the health sector offers, there are key elements that will have to be improved not only in clusters activities as in knowledge of health and focus on exports that will have to be improved so that industry can be successful in this field.

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1. Introduction

During the last two decades, there was a considerable increase in the capacity to develop and manufacture systems that employ smart components highly integrated and miniaturized [1]. Because of this remarkable development, pervasive computing is nowadays part of our everyday and social life and impacts our surrounding environments. Pervasive computing is a multidisciplinary research field aiming the development of appliances and applications to allow convenient access to relevant information and services. It involves technologically oriented research on topics like embedded hardware, software, middleware, wireless communications or cloud computing, among others.

One of the most important application areas of pervasive computing is healthcare. Pervasive health can contribute, with different roles, to personalize healthcare and wellness services, by promoting an evolution from a medical approach to individual-centric operational models, in which the individuals become active partners in their care process [2].

Within the pervasive health paradigm, different groups of technologies, although focused in specific aspects, can contribute to an idealized model of care personalization. Among these groups, mobile health (mHealth) [3] and Ambient Assisted Living (AAL) (i.e. the

development of the Ambient Intelligence concept to enable elderly with specific demands to live longer in their natural environments) [4] have been object of relevant research.

Pervasive health requires highly demanding software solutions. This document is the result of a research study to evaluate how Portuguese growing software industry is prepared to create solutions for global opportunities in the healthcare market. In this chapter, three subjects are explored: the fundamentals that motivated the research study, the respective objectives and the structure of this document.

1.1 Fundamentals

The healthcare market is mainly constituted by funders (e.g. governments, insurance companies or healthcare subsystems), by providers (e.g. hospitals, health centres, clinics or diagnostic labs) and suppliers (e.g. medical devices, pharmaceuticals, information technologies, food and other needs to healthcare delivery). Other intervenient elements are regulators, research and development centres and patient's organizations. As healthcare is moving to be more centred on the patient, this will affect all the player's activities and market rules may come to be different in the future. Funders will like to see their investments more justified and controlled, the providers want to show their efficiency to be well recognized and paid by funders, based in the contribution of their activities to the patient's outcomes, and the suppliers will like to show their efficacy and demonstrate their added value to the patients, and their contribution to the patient's outcomes as well. Also, other stakeholders as regulators will be able to better analyse providers activities and create standards to improve quality and safety in the sector. All these players will need to show more differentiation to create and prove their added value to the system and this trend, to be succeeded, requires information technologies.

According to an expert on customer centricism with experience in different areas [5], the patient centric orientation in healthcare sector will experience the same that happened with finance sector. In the eighties, finance sector needed to move to be more consumer centric, introducing technology that required high compliance levels due to data collection, and needed to be able to understand the market behaviour. With patient's

clinical records being digitalized, healthcare sector will require more security and compliance as well, and patients, as the consumers in finance market, will be able to recognize more quality as the efficacy and efficiency are introduced and demonstrated through the introduction of information technologies.

So, as finance experienced when ATM's were introduced, first without profitability and then, after the infrastructure change, moving from a cost centre to a significant source of revenues, the healthcare sector may invest now in data management infrastructures and platforms to better manage patient's information and to deliver high quality services. Mobile technology will also be a key factor for patient's experiences, to increase providers and caregiver's communications (e.g. data collection and transmission by means of monitoring devices), to retrieve the patient's clinical information or to enable payments and information sharing among payers, providers and suppliers.

Healthcare, differently from other sectors, is not a straight line, there are a lot of intervenient elements requiring access to information that sometimes is not consistent. Hospitals are visited by patients with different individual plans and services are not standardized as in other sectors. Therefore, patients get confused in the systems, being difficult for them to choose the best service, the best physician, and the specific technology or procedure [5].

That means a huge opportunity for information technologies to help the sector to be more efficient. So, the healthcare sector will need more information exchanges to accelerate the transition to the patient centrism. We will assist to the development of medical home monitoring, among other systems and services, or the improvement of the communications among physicians, patients and funders. Even the clinical research can gain from this evolution, getting evidence to the best treatment approaches.

Pharmaceutical products and medical devices are industries strongly recognized as intensive innovation pushers by developing their products through other diversified industries: pharmaceuticals result from chemistry and biotechnology; and medical devices as a combination of products coming from the same and many other industries, like textiles, electronic, plastic or glass. Differently to pharmaceutical products with lifetime extending their life cycles for decades, the medical devices are about to be

upgraded every twenty-four months or even less, with a high competition environment and multiple companies on the field, working very closely with healthcare providers, and helping daily to give the best treatment for patients. The environment is highly competitive, both in market and research, which means that the development and launch speed can be success factors, but quality and safety will always be more important for technologies' survival.

Medical device's industry has been reported by "Business Wire" to have a very positive trend with good opportunities in private and public hospitals, expected to overpass \$400B worldwide by 2023 driven by healthcare expenditure, technological development, population ageing and the increase of chronic diseases. A good part of technologies used for medical device's development are linked to software, and a software application can also be considered a medical device.

In the process of the patient centrism, the suppliers are also interested in proving their efficacy and they will like to change old business models for Value Based Health Care (VBHC). So, they will need to help and sell to providers good control and information systems to better assist the patients. So, all the intervenient elements on healthcare sector, payers, providers and suppliers, are requiring important investments on software, and their future depends on it, making this sector an important field for research, investment, specialization and clustering.

Looking at the Portuguese reality, the software industry has been considered as a Silicon Valley with a consistent growth perspective for the future. Portugal got the knowledge, the people, the skills (as for example the Lisbon Web Summit) and the infrastructures that are bringing high investment, both national and international to this area. Politically the last Governments were supporting and gave a strategic importance to the software industry, similarly to other industries in the past, looking for a national specialization to attract investments and push the economic growth.

Moreover, there is a connection between the industrial country tradition and the ability to develop healthcare products. Portugal has been traditionally a good textiles' exporter and consequently a good exporter of medical devices based on textiles. We also had good

experiences in glass medical devices, when glass industry was a specialty in Portugal, in the Centre region.

The question is how to motivate industries where Portugal have been successful to develop medical devices, an area with a shining future, with more and more people needing technology support for keeping their lives with quality, autonomy and independence.

1.2 Healthcare and Economics

All countries in the world want to grant a healthier and longer life for their population. Over the time, populations are increasing their longevity all around the world due to economic development and healthcare improvements and coverage. Healthcare sector is an important economic sector involving many areas such as products, services, caregiving, disease monitoring, insurance, politics and others, which explains its complexity and special characteristics when comparing to other sectors. In a normal market we have as most interested parts, the buyers and the sellers. Buyers can judge what they receive from sellers and they pay directly the acquired goods and services. The market prices determine the decisions of market participants. The market system leads to an efficiency of resources allocation [6].

In healthcare market all those aspects are different. The most interested in healthcare outcomes are payers as insurance companies and governments. The patients, supposed as buyers, often don't know what they want or need, and are not able to judge the treatments that are given to them. The healthcare providers are not mainly paid by the patients, but from the insurance and healthcare systems, that instead of paying the price they just allocate resources. All this deviation from a normal market does not necessarily leads it to an efficient resource's allocation.

In fact, the healthcare market is looking to get more efficiency and all the participants need to have more standardized information. The inefficiency can be flighted by mechanisms where clinical outcomes, pay-out systems, invoicing, disease monitoring, patient empowerment, education, clinical trials, and so many other aspects can be

supported with information technologies, which means that automation and software can play a decisive role in the next coming decades. The participants on this market, as suppliers of goods such as pharmaceuticals, medical devices or service's solutions, or even a combination of all, to improve the access of populations to their solutions in a gaining efficiency model, can take an important role: they can contribute to expand the economic opportunities of a country.

Particularly, the multinational companies have the capacity to contribute with inclusive business models by creating and offering complete solutions around the products they sell in a country (e.g. working locally to add value to the products, as adjusted packaging, complementing clinical services or facilitating the instruction of information technologies' services [7]). Those companies have also the capacity to build initiatives such as, for example, educational programs for healthcare institutions, that may expand new opportunities for the local economy and infrastructures. Those big market participants can help and influence the regulation of the market in a way that increase economic opportunities by creating a better business environment.

It is understandable that all the stakeholders in the healthcare sector need reliable information to contribute for the healthcare sustainability, by integrating healthcare sector as a productive and economic sector. And the process must help governments to keep in mind that economy is the common vector that allows countries to find resources to improve healthcare for citizens. But governments may also be focused in developing the economy of the healthcare sector itself, since is one of the sectors showing consistent growth and economic importance in the world. The Health Cluster Portugal (HCP), measured the importance of healthcare production in the national economy, and find out that both pharmaceuticals and medical device's exportations represent more than wine or cork exportations, so traditional Portuguese exporting industries. This evidence changed the normal thoughts about considering healthcare as a spending resource's area, changing to a concept that also considers the creation of value.

Ministries of Health and Economy have been looking with different eyes to the industrial production related to the healthcare provision. This reality is not possible to be measured looking exclusively for pharmaceuticals and medical devices. However, healthcare

services and software sales contribution are not able to be calculated, since their activities are not economically codified at the level of national economy, so far. We need to know if the dimension of healthcare economy on exportations will become higher once we can measure healthcare software contribution.

Recently we have observed a very positive dynamic in the healthcare sector. The private hospitals are expanding their offer with more innovative solutions, including high technology treatments, and are exploring markets such as healthcare tourism [8]. The operational and management activities both in the private and public segments are improving their efficiency and efficacy [9],[10]. There is evidence of an increase of the clinical trials in Portugal [11]. And we have local molecules patented by national companies and used worldwide, as a top evident prove of this great development [12],[13]. In parallel, we notice the interest of big software companies like Amazon and Google to locate and expanding strategic offices in Portugal, as an incentive to develop the software production in Portugal and to animate the start-ups creation [14].

The population ageing, and the increase of chronic diseases are putting healthcare systems in stress since the normal care of people be not sustainable under the traditional terms. It is expected a deep change of the healthcare sector to keep the systems funding universal care for all citizens. Only technology can be a scape to let patients be better controllers of their treatments, and to be active, autonomous and independent. The healthcare provision will need to have more and more information to take decisions in terms of the funding of the technological investments. At this point, the software for healthcare and all the pervasive technologies can take a fundamental role on the healthcare economic growth.

1.3 Objectives

To determine how is the future being prepared by healthcare software companies in Portugal to access the healthcare global market, the intention of this research is to measure how are the Portuguese software producers distributed in terms of company characteristics, such as volume of sales, people, education levels, external experience,

exportations, distribution channels and focus on healthcare. Then, by proposing a segmentation for healthcare software, the objective is to measure how are those healthcare products targeted, by users, local to be used, objectives and other subjects. All these aspects can give us more quantitative elements by crossing statistically significant data, found over a survey to be answered by a representative number of software producers located in Portugal.

Another objective is to evaluate if Portuguese healthcare software industry present similar characteristics to the common characteristics of the Portuguese industries that are successful in the global market.

Finally, other objective is to reach evidence to define a good strategy to develop healthcare software in Portugal. It is critical to know what the relevant aspects to export are and what is the actual awareness level about the international opportunity of this sector.

Demography, active ageing, chronic diseases, telemonitoring, patient empowerment and other areas have a huge future impact and it is important to know how prepared our software producers are to face those challenges.

1.4 Structure

After this first chapter with the introduction, this document includes a second chapter (Healthcare, Ageing and Technology) with a revision of technological solutions to determine aspects to be considered in the research study and to establish a proposal to segment the products of healthcare software.

The third chapter (The Industry Characteristics) will be dedicated to characterizing the software industry itself in Portugal, how is it organized, what is its global volume, how much people does it involves, what has been done strategically to grow, what are the links to academic centres and what are the respective specialized segments, if they exist. Also, we will explore software industry success factors to survive and to grow both nationally and internationally.

The fourth chapter (Methods) will define the experimental study and the methods to collect and analyse the data that support the present thesis.

The fifth chapter (Results) will show the results that characterize the healthcare segment of the Portuguese software industry, and the sixth chapter (Discussion) will present the discussion of those results.

Finally, the last chapter, the seventh (Final Conclusion), will concentrate the conclusion of the present study.

2. Healthcare, Ageing and Technology

2.1 Introduction

Nowadays, software technologies assume a vital importance on the quality of healthcare delivery with impact on the expectancy and quality of life of the citizens. The high and accelerated growth of the number of applications (apps) associated to the dissemination of the use of smartphones, personal computers, tablets, and sensors, the expanded use of healthcare information, together with the demographic ageing phenomenon and the cultural and societal changes are the fundamentals for the study reported by this thesis.

Healthcare is commonly seen as an expense by funders and patients but in a macroeconomics view, we must have in consideration that healthcare is a market where players can add value to the economy. Industries like pharmaceuticals and medical devices may represent an important contribution for Gross Domestic Product (GDP), especially when they have an exportation dimension. Despite software applications be considered as medical devices when linked to patient's data, this segment needs more regulation and quality control. Differentially to other industries and markets, the future of software for healthcare is quite predictable and it is possible to introduce long-term strategies. The predictability of this market is linked to the world demographic evolution

and to the global empowerment of the patients given by knowledge to health conditions self-control and to wish of having access to healthcare technologies.

2.2 Demography and Software Framework for Healthcare

According to the United Nations reports, in 2000, the world had 600 Million people over 60 years old, three times the number registered in 1950. The extrapolation is to have two Billion people over 60 years old in 2050 (three times again, only in a timeframe of fifty years) [15]. That means to have approximately 20% of the population above 60 years old [16]. The increasing ageing of the population will bring an increase of diseases, an increase of healthcare costs, a shortage of caregivers, and an increase of patient's dependency, which will impact the organization of our society [16].

Non-Communicable Diseases (NCD) are the main causes of death. About 860 Million people reported a long-standing health condition or disability with NCD [15]. Also, there is evidence related to disease burden and loss of economic output associated with chronic diseases - mainly cardiovascular diseases, cancer, chronic respiratory diseases, and diabetes. This disease burden was estimated to cause more than 60% (35 million) of all deaths in 2005; more than 80% of these deaths occurred in low-income and middle-income countries. Previously, it has been projected that, in 2015, 41 million people had died from chronic diseases without consolidated prevention and control actions [17]. Achievement of the global goal of reducing chronic disease death rates by an additional 2% every year would avert 36 million deaths between 2005 and 2015 [17]. The World Health Organization (WHO) [18] estimates that all deaths related to NCD in the world grew up from 60% in 2000 to 68% in 2012.

By 2009 there was about 4.6B cellular phones around the world, already with 100% penetration in developed countries, and smartphones were rapidly cannibalizing them [15]. In US, about 53% of cellular phones were smartphones [19], and developed countries as UK may have from 80% to 90% of the populations using smartphones by 2021 [3]. Healthcare providers are rapidly adopting smartphones; more than 80% of US

physicians may have already adopted this platform [20]. About 50% of smartphone users use health information and 20% own health apps [19]. Smartphones, associated with other technologies such as Global Positioning System (GPS), offer conditions to improve life independence of disabled people and chronic patients as well permit better surveillance of epidemiology and public health. They also allow community data collection [19]. In particular, the mhealth worldwide market was expected to have a value up to \$23 Billion in 2017 [15]. There was evident potential for mhealth technologies to transform healthcare processes to save between \$2 and \$6B worldwide in 2014 [15]. In 2012 the number of healthcare related applications available in the market were no fewer than 40,000 [17].

As important segments of the pervasive health market, a review of the benefits of home telecare for elderly and long term condition patients, the most effective telecare interventions appear to be automated vital signs monitoring (for reducing healthcare service use) and telephone follow up by nurses (for improving clinical indicators and reducing healthcare service use), but we still need more evidence about the effects of home safety and security alert systems [21].

2.3 Healthcare Expenditure Growth

During the last decades the Health Care Expenditures (HCE) has been extensively studied. A main observational analysis indicates that HCE depends on remaining lifetime but not on calendar age, at least beyond 65+ [22]. The positive relationship between age and HCE at age of 80, for example, may be caused by the fact that there are many more individuals in the last two years of lifetime at that age. The real causes of HCE growth are mainly related to failures in insurance market and funding agencies, limited technology access and wrong incentives for patients, healthcare providers and hospitals caused by government regulation of the healthcare sector [22].

Elderly people in better health conditions may have a longer life expectancy than those in poor health conditions but have similar cumulative HCE until death. The expected cumulative HCE for healthier elderly people, despite their growing longevity, seems to be

like those for less healthy persons, despite their lower longevity. So, health promotion efforts at people under the age of 65 may improve health and longevity of the elderly without increasing healthcare expenditures [23].

Ageing will not contribute much to the future growth of per capita HCE, but may influence the component of long term care, causing the financial burden on the younger generations to increase [24].

There is an additional influence that may reinforce the impact of ageing on the future HCE, by shifting the vote to allocate more and more resources to public healthcare [24].

It is very important to predict with accuracy the future demand and expenditure of healthcare facing the ageing challenge, especially for healthcare funding systems such as national health systems. Even complex models where a combination of factors on top of ageing such as Life Expectancy (LE) and Disability-Free Life Expectancy (DFLE), taking in consideration aspects as morbidity delay following LE, the conclusion is that HCE growth must be controlled and adjusted to the resources [25].

There is an evident disproportional budgeting focus for healthcare in terms of percentage of GDP when we analyse data from 2006 where globally was 8,7%, between 12,8% in US and 3,4% in South East Asia Region. In other hand the government participation also differed a lot, from 76% in Europe and 34% in South East Asia Region. During the last years Europe is trying to stop the growing rate trough cost control strategies. But we assist to a situation where citizens are asking for more healthcare and social care, and possibly a new market will come citizen-driven according to the economic development [26].

During the last decades the healthcare economists and funders have been focused on cost control and one of the concerning areas is innovation, normally seen as a cost inductor. The selection of the type of technology to adopt is fundamental and there is evidence that the choice of highly cost-effective “home-run” innovations with little chance of overuse (e.g. HIV anti-retroviral therapies) and other treatments highly effective for some but not for all (e.g. stents) gain greater health conditions improvements in the adopted countries comparing to other that adopts treatments with

uncertain clinical value, such as intensive care units among chronically ill patients that brings in fact the most rapid cost growth [27].

Technology such as Electronic Health Record (EHR) systems can produce efficiency and safety enough to reduce substantially the healthcare expenditures if barriers as implementation costs and disruptive effects on practices are overpassed [28].

2.4 The Global Market

2.4.1 Main Aspects

Healthcare sector, in terms of the supply of technologies and services, is so international as any other, even in terms of healthcare provision, following tendencies as tourism and border healthcare, for instance. In general, the world economy is becoming more open, and distances are getting shorter. Global healthcare technologies market, that includes medical technologies, medical imaging equipment, diagnostics in vitro and healthcare provision supported by information technologies, may reach \$600B by 2018, showing year growth rates from 4,4% to 10%. Healthcare provision supported by information technologies is close to 20% of that volume, growing 6,4% and is the second biggest industry in this group [29].

Any company wishing to grow and to survive must have the notion of global market. Traditional theories posit that firms go through stages as they progress toward becoming international (e.g. Uppsala model [30]). In those models, firms grow in their domestic markets before they start to export extensively. Since to export is necessary knowledge and resources acquired with experience, first the aim is the domestic markets and then the larger foreign markets [31],[32]. This behaviour is particularly prevalent among firms operating in small open economies and emerging nations, where domestic demand may be limited [31].

Alternative views suggested that there are firms that internationalize soon after their inception. The global phenomenon is most prevalent in knowledge-intensive firms, with low marginal costs, when even they are small they can bypass the home market and

target foreign markets. Software industry is probably the most that can face the market as global, able to produce in any part of the world and deliver in a different place of the planet, sometimes working at distance and with none or limited personal visits between customers and suppliers. Software companies may start in any open economy and since the very beginning they can see the market as global, so called born-global. The findings of observational studies in small firms of small countries suggest that internationalization process in small software firms is influenced by domestic and foreign client followership, the targeting of niche markets and industry specific considerations, rather than by the psychological or geographic proximity of export markets [32].

2.4.2 Market Selection Decisions

The international market of software may follow different ways, but when companies don't go directly, they usually go through agents or distributors. Other ways than go directly with export sales staff, are indirect exports (supply software to indigenous third parties which produces and exports integrated systems), licenses (e.g. on line or in sites), joint ventures or through subsidiaries in the external market. Maybe due to the fact of software products have short life cycles, the direct approach is probably the most effective and fast way to sell abroad [32].

The key factors for software firms to go global must be analysed through the way how companies make market selection. Some companies will start to explore markets close to their culture. Norwegian companies may start to export to Sweden, UK or Denmark, as Irish companies go to countries as UK, Canada and US. Important factors to be evaluated in this process are diverse. Moreover, there is some evidence that domestic client followership not only encourage small software firms to begin exporting in the first place and determined the choice of exports markets, but also that it had a significant bearing on the market mode. When companies start to export as a result of an unsolicited order from abroad, the positive reaction for such stimuli is normally linked to psychological or geographical proximity [32].

Specific research about software companies developed in 1995 [32] reveals little influence of this factor for the decision about the foreign markets to go. However, more

recent research in 2010 [33] targeting a large range of exporting companies including information technologies, shows relevance of psychological or geographical proximity on the process. This research defined psychic distance as the individual's perceived differences between the home and the foreign country, which is related to different categories in the operationalization side: culture difference dimensions (e.g. language, education, political and legal systems or level of industrial development); national indicators; or indicators related to the perceptions of the companies' managers. The psychic distance scale gains a different orientation when is supported by the managers perceptions and must be measured in two dimensions: country characteristics distance (i.e. differences between home and foreign country regarding level of economic and industrial development, communication infrastructure, marketing infrastructure, technical requirements, market competitiveness or legal regulations) and people characteristics distance (e.g. per capita income, purchasing power of customers, lifestyles, consumer preferences, level of literacy and education, language and cultural values, beliefs, attitudes and traditions) [33].

For those nations that have already succeeded in terms of their industry there are several factors that explain their success, namely [34]: government vision and policy, by developing infrastructures like communications or by funding, encouraging the success of high tech industry as a strategic action for economic development; competitive human capital that emerges only after many years of national investment; quality of life standards to attract talent, as seen, for instance, in Florida, Seattle, Austin, Stockholm or Bangalore; wages, since the buying of the so-called offshore outsourcing services tend to found the lowest cost supplier; the existing industry, since the national industry success is driven by the coherence of the industry vision and strategy in defining the industry focus; the capital sources, such as government funds, venture capital and investment capital, equity offerings and foreign aid; technological infrastructure, namely abundant, reliable and cheap telephone and broadband data connections; and linkages, such as linguistic and cultural proximity or diaspora.

2.5 Technological Applications for Healthcare

When analysing the applications of technological solutions such as the pervasive health solutions to support healthcare, different perspectives can be considered, namely in terms of target users, objectives or application domains.

According to [3], [19], [20], [21], target users might be caregivers (e.g. physicians, nurses, healthcare providers, and who are taking care somehow of the patients), patients (e.g. chronic and other patients), and elderly.

Taking a review of studies dedicated to smartphones applications, almost 70% of referenced healthcare apps in the market are targeted for the healthcare providers. In this group the main areas are disease diagnosis (37%), medical calculators (14%) and general healthcare apps (12.5%) [3]. There are other areas, such as software applications providing clinical contents or drugs references, with some dimension [3], [19], [20]. Looking for the patients, the most common chronic diseases targeted by manufacturers are probably diabetes and heart failure and about 18% of published studies related to apps are dedicated to this group [21]. In terms of elderly, there is a strong development of applications aiming to promote proactive support from practitioners to improve clinical outcomes.

In terms of objectives, it might be considered [3], [4], [17], [35]: individual applications linked to what a person uses to control health data or signs, useful to monitor health conditions; health control and diagnose, such as home monitoring; education (e.g. medical and nursing students); data base applications to preserve health data; or community care (i.e. applications promoting direct links to patient's homes without intermediary healthcare providers).

Finally, the different technological solutions can be analysed according application domains, a perspective that will be followed in the present document. According to a systematic review performed by Pereira et al [36], the scientific literature reports different technological solutions targeting the following application domains: healthy lifestyles, loneliness and social isolation, home safety, and remote care of chronic conditions.

2.5.1 Healthy Lifestyles

When dealing with healthy lifestyles the research related to use of different technological solutions is focused on health education, physical activity, nutrition and weight management. These results are consistent with the most common inappropriate behaviours affecting the industrialized countries' populations [37].

2.5.1.1 Health Education

Diverse range of media platforms (e.g. collaborative projects such as Wikipedia, content communities such as YouTube, social networking applications such as Facebook, or social worlds such as Second Life) are the foundations of the web 2.0 paradigm, also known as social media [37], which allows the creation and exchange of user generated content about health issues. Authors [38] evaluating the contribution of the social media for health communications to the general public, patients and healthcare providers conclude that a significant percentage of the studies are exploratory or descriptive. They suggest several benefits of the social media, including: increased interaction with others; more available, shared and tailored information; increasing accessibility and widening access to health information; peer support; and potential influence of healthy policies. However, reliability, confidentiality and privacy are general concerns when using social media to communicate health issues and the quality and reliability of the exchanged information is quite diverse [38].

Information technologies also offer a medium to assist healthcare providers to meet educational-related responsibilities, including interactive computer-based education programs [39] that can be viewed at home or during periodic clinic visits. Other studies reported the use of different technologies (e.g. social media or personal health records) for citizen's education [38],[39],[40],[41],[42],[43], covering a diverse population in terms of age, sex, education level, health status and healthcare intervention or disease state. The programs show significant variations in terms of features, implementations and integration strategies.

2.5.1.2 Physical Activity

Physical activity is one aspect of lifestyle changing that might be effective in reducing rates of hospital admission and reducing the risk of mortality. Increasing physical activity to low or moderate levels can result in lower risk of mortality from all causes.

Several studies consider the promotion of physical activity among the behaviour change interventions [40],[41],[44],[45],[46],[47],[48],[49],[50],[51],[52]. There are many applications that suggest a range of physical exercises, complemented with demo videos and the measurement of several outcomes.

When reported as an outcome, physical activity is being measured through validated questionnaires (e.g. the Short Questionnaire Assessing Health-enhancing - SQUASH, the Baecke Physical Activity Questionnaire, or the comprehensive evaluation of the Minnesota Leisure Time Physical Activity Questionnaire), and quantitative measures [53]. Examples of quantitative measures are steps per day or minutes of weekly exercise [54] that can be performed by different types of devices [45],[55].

Technological applications appear to have positive effects on physical activity behaviours [44],[45],[47],[49],[50],[52], but the results are not consistent [44]. For instance, a review [45] reports that within the 14 randomized controlled trials (RCT) being analysed, six studies found that the intervention group had significant differences compared with the control group, four studies had mixed results, and another four had no significant differences between groups.

However, the most studies are characterized by small sample sizes, heterogeneous effect sizes, and a lack of analysis of the cost-effectiveness of the interventions, especially in conjunction with clinical practice.

2.5.1.3 Nutrition and Weight Management

Several studies [41],[44],[50],[53],[56],[57],[58],[59],[60] deal with nutrition and weight management. In terms of nutrition several studies reported nutrition applications able to capture dietary intake [57],[58] that can be divided into applications that allow controlling calories and keep food diary (e.g. applications that allow users to select food and portion

size or applications that process food photographs taken by the users), and specific applications for food safety, namely considering people with allergies.

Overall, positive feedback was reported: the use of nutrition applications resulted in better self-monitoring adherence and changes in dietary intake when compared to conventional techniques (e.g. paper records).

Concerning weight management, remote interventions are being delivered using a wide range of technologies, including web-based applications and smartphone applications, or even more traditional methods, such as telephone calls. The interventions might include: counselling or advice; self-directed or prescribed exercise; home based or facility-based exercise; and written education or motivational support material, namely the promotion of knowledge using serious games [40].

In terms of outcomes, questionnaires such as the Food Frequency Questionnaire (FFQ) or the MEDFICTS score have been used [53]. When compared to control groups, the majority of primary RCT studies of the included systematic reviews and meta-analyses pointed a significant net difference in weight between the intervention and control groups. This is valid for different types of technologies (e.g. web-based applications [57]), but is particularly evident when mobile applications are being used (e.g. periodic prompts of a smartphone applications [44],[50]).

2.5.1.4 Loneliness and Social Isolation

Researchers report that the impact of social relationships on the risk of mortality is comparable with major, well-established risk factors such as smoking and alcohol consumption, and exceeds that of physical inactivity and obesity [61],[62].

A systematic reviews and meta-analyses [63] analysed 26 primary studies (six primary studies were RCT) related to the use of technological solutions to surpass social isolation. There are interventions in all studies, but two primary studies were implemented in the regular living environments of the participants.

Several implementations used some form of web-based or mobile applications, while others are related to telephone befriending intervention, videogames and the use of a

visual pet companion application that allowed the older adults to interact with an avatar in real time [63].

Technological solutions were consistently found to affect social support, social connectedness, and social isolation in general positively. Technological solutions can facilitate several mechanisms, including connecting to the outside world (e.g. family members, especially grandchildren, friends, former colleagues or new contacts of shared interests) and, mostly important, boosts self-confidence and empowerment which trigger positive feelings of the participants and their control over life and/or life satisfaction [63]. Although the potential impact of technological solutions might have in the promotion of social contacts, more well-designed studies on the effect the interventions and the identification of how the training and implementation of such interventions should be tailored to maximize their effects [63].

2.5.2 Home Safety

Several types of technologies (e.g. personal alarms, home automation systems, video monitoring and smart technologies such as bed sensors, kitchen sensors, motion sensors or fall detection sensors) are being used to help older adults to overcome emergencies [64].

Older adults reported improved safety, independence and confidence, particularly when technologies with real time monitoring are connected to a response system [64]. However, there is still a lack of robust evidence, and applications aimed at predicting, monitoring and preventing should consider intrinsic factors related to older attitudes around control, independence and perceived requirements for safety.

2.5.3 Remote Care and Chronic Conditions

Concerning the use of technological solutions to optimize the care of patients with chronic conditions, several systematic reviews and meta-analyses deal with home monitoring of older adults with chronic diseases [36],[65],[66]. In addition, the promotion of the empowerment of older adults and their informal caregivers is also subject of a

significant number of the studies. Furthermore, several target chronic diseases are being considered, namely, diabetes, congestive heart failure, chronic obstructive pulmonary disease, hypertension, mental health or cancer.

2.5.3.1 Diabetes

Since self-management of diabetes requires patient adherence to best practice recommendations (e.g. glycaemia control, dietary management or physical activity) there has been an interest in increasing compliance of self-care applications: self-management and care knowledge [67],[68],[69],[70],[71],[72],[73]; prescribed medication adherence [72],[74],[75]; and behaviour outcomes (e.g. diet and healthy eating or physical activity) [67],[68],[69],[71],[72],[73],[74],[75],[76],[77],[78],[79],[80].

A significant number of articles focuses both type 1 and type 2 diabetes [69],[71],[76],[79],[81],[82],[83],[78],[84],[85]. Other articles focus type 2 diabetes [67],[68],[74],[80],[84],[86].

In technological terms, several articles [67],[68],[69],[70],[71],[79],[84],[87],[85] refer web-based applications. In general, these applications allow synchronous (e.g. instant messaging or chat) and asynchronous (e.g. electronic mail or bulletin board) communications together with web pages to register clinical parameters (e.g. weight or blood pressure) and medication.

Besides web-based applications, there are other technological solutions reported in different articles:

- Computer-assisted applications integrating the management of clinical data with electronic practice guidelines, reminder systems, and feedback to the patients [69],[86].
- Smartphones (e.g. standalone smartphones or smartphones integrating specific devices such as glucometers for automatic glucose level upload) [68],[69],[70],[72],[74],[78],[82],[85],[88].
- Automatic patient data transmission by means of monitoring devices (e.g. devices to monitor vital signals or devices to monitor behaviour outcomes such as

pedometers or accelerometers connected by wireless communications to monitor physical activity) [81].

- Video-conference [69],[76].
- Telephone calls [79].

The main outcome of most of the research related with diabetes is the control of glycaemia by using glycosylated haemoglobin (Hb1c) as a proxy. However, in general, this aim is complemented with other health related outcomes (e.g. health related quality of life [67],[71],[76],[87], weight [67],[70],[78],[84], depression [70], blood pressure [76], [78],[79][83], cholesterol level [67],[87], triglycerides level [87], or fluctuation index [67]), behaviour outcomes (e.g. physical activity) [67],[76],[71],[74],[78],[79],[80],[86], patient self-motivation [85], patient-clinician communication [85], medication adherence [57], and structural outcomes related to care coordination [81],[76].

A significant number of studies report moderate to large significant reduction of Hb1c when compared with usual care [68],[72],[74],[76],[78],[79],[80],[83],[86],[87],[88],[84], [85]. However, several studies are not conclusive about the reduction of Hb1c [67],[70],[76],[82]. Computer-based diabetes self-management interventions [59] and consultations supported by video-conference [76] appear to have a small beneficial effect on glycaemia control.

In terms of research gaps of the technological approaches, there is the need to improve the usability of the applications as well the need for more comprehensive solutions, including real-time feedback to the patients and integration with EHR systems [69].

2.5.3.2 Congestive Heart Failure

Concerning technological solutions to support patients with congestive heart failure, automatic patient data transmission by means of monitoring devices [89], [90], [91], [92], [93] is being used together with video-conference and standard telephone calls [94], [95], [96], [97] to allow the assessment of symptoms and vital signs, as well as the transmission of automatic alarms.

In terms of clinical outcomes, the main concerns are the impacts of home monitoring in heart failure-related hospitalizations and all-cause mortality [96] when compared with

usual care. However, several secondary outcomes are also considered such as self-care behaviour (e.g. adherence to prescribed medication, daily weighing or adherence to exercise recommendations [92]).

Home monitoring seems to have a positive effect on clinical outcomes of patients with congestive heart failure. Home monitoring reduces mortality when compared with usual care and it also helps to lower both the number of hospitalizations and the use of other healthcare services [90],[91],[93],[96].

However, there is a need for high-quality trials [94]. Additionally, Grustam and colleagues [86] state that evidence from the scientific literature related to home monitoring to support congestive heart failure patients is still insufficient. Also, more comprehensive economic analyses are needed to reach a sound conclusion. This means that further research is required in terms of comparisons of home monitoring with usual care of patients with congestive heart failure.

2.5.3.3 Chronic Obstructive Pulmonary Disease

Home monitoring is supported by commercially available devices to measure and transmit different types of information (e.g. weight, temperature, blood pressure, oxygen saturation, spirometry parameters, symptoms, medication usage or steps in 6-minutes walking distance) of patients with chronic obstructive pulmonary disease. In some cases, the automatic data acquisition is complemented by telephone interviews of clinical staff using questionnaires [98],[99], or by telephone or video-conference calls to provide feedback to the patients [60]. In this respect, telephone and videoconference calls when used to provide feedback are associated to improvements in the quality of life of patients with chronic obstructive pulmonary disease [60].

In what concerns the primary and secondary outcomes, there are studies [98],[99],[100], comparing home monitoring with usual care of patients with chronic obstructive pulmonary disease, considering mortality, admissions to hospital or other healthcare utilization as primary outcomes. Secondary outcomes include, among others, health related quality of life, patient satisfaction, physical capacity and dyspnoea.

Home monitoring was found to reduce rates of hospitalization and emergency department visits, while the findings related to hospital bed days of care varied between studies [98],[99]. However, a greater mortality in a telephone-support group compared with usual care was also reported [98]. Additionally, there is evidence that home monitoring has a positive effect on physical capacity and dyspnoea [60] and it is similar or better than usual care in terms of quality of life and patient satisfaction outcomes [80].

2.5.3.4 Hypertension

Concerning patients with hypertension, the results of RCT using devices with automated data transmission together with video-conference calls to monitor patients with hypertension [101] show improvements in the proportion of participants with controlled blood pressure compared to those who received usual care. However, the authors conclude that more interventions are required, and cost-effectiveness of the interventions should also be assessed [101].

Other study [102] related to the empowerment of patients with hypertension concludes that web-based or computer based applications change the care knowledge and impact self-efficacy and self-care behaviours.

2.5.3.5 Mental Health

Concerning mental health, the literature reports web-based applications [75],[103], and videoconference [104] to support people with psychosis, computer-based and web-based applications to support people with depression [105],[106], and computer-based applications to support people with dementia [107].

Patients with psychosis seem to use the internet more frequently than control groups for the purposes of social networking, but participation varies across studies. Concerning the use of videoconference to treat people with psychosis, findings generally indicate that patient care via videoconference is equivalent to face-to-face therapy, but also offers numerous advantages such as reduction in the need for patients and healthcare providers

to travel [93]. However, the heterogeneity, poor quality and early stage of the reported research precludes any definite conclusions [103].

In terms of patients with depression, a study [106] argues that there is evidence that supports the effectiveness of different treatments for depression and highlights participants satisfaction, but a second study [105] considers that there is insufficient scientific evidence regarding the effectiveness of computer-based cognitive behavioural therapy and self-help web-based applications in terms of the management of depression. Furthermore, there is a strong hypothesis that videoconference-based treatment obtains the same results as face-to-face therapy, and that self-help web-based applications could improve depression symptoms when traditional care is not available [107].

A study related to dementia analysed the usability and acceptability of the applications as well as the engagement, participation and enjoyment of the participants [96]. Benefits include the enjoyment derived by people with dementia from viewing reminiscing materials through various forms of multimedia, such as video and audio. However, many of the systems described, require technical expertise for setup or operation and may not be ready for independent use by family caregivers [107].

2.5.3.6 Cancer

To mitigate the undesirable side effects that can negatively affect the quality of life of patients with cancer, their empowerment is important. The patient's empowerment can contribute to them being autonomous and respected, having knowledge, or psychosocial and behavioural skills, receiving support from community, family, and friends [108]. In this respect, technological solutions can support knowledge transmission, including electronic survivorship care plans, patient-to-patient and patient-to-caregiver communication, and electronic patient-reported outcomes [108].

Technological solutions (e.g. computer-based and web-based applications) were found to be effective in different health outcomes such as: pain, depression and quality of life [109]; fatigue, depression, anxiety, and overall quality of life [110]; knowledge; satisfaction; and other outcomes which were both directly and indirectly related to the healthcare interventions [111].

2.6 Conclusion

The development of healthcare applications must consider a variety of possible dangers. One aspect to be considered is the risk of the reduction of the human relations, particularly between patients and healthcare providers. Therefore, technological solutions should not interfere on the quality of the human relations. Moreover, since technological solutions manage different types of personal information, including clinical data, there could be serious problems related to privacy of older adults, which might be exacerbated when using mobile technologies, such as smartphones (e.g. when a smartphone is lost, and the control or accesses is not performed).

Concepts like usability and accessibility should be widely expanded in the society but that requires technical and cultural changes. Systems are normally developed without any focus to be adjusted to specific needs as elderly, disable or unhealthy people. The level of interest for these concerns still very low and requires a strategic commitment of manufacturers and designers to certify their solutions on these aspects. The concept of universal access must be emphasized and more regulation is required in order to improve focus on this important issue [4],[16], [112].

Since even highly educated people may experience difficulties in understanding instructions or other healthcare-related information, there are significant problems in terms of health literacy that can be exacerbated when dealing with older adults. Moreover, health literacy is part of a complex issue known as 'digital divide', which is related to the existence of a gap between people who can effectively deal with information and communication tools and those who cannot [38] (e.g. difficulties in accessing specific services due to non-existent adequate communication infrastructures). Therefore, technological solutions to support healthcare might require specific training interventions for all the stakeholders, to minimize potential risks and to promote their dissemination. This could be useful to take advantage of their enormous potential.

3. The Industry Characteristics

Before characterizing the industry of software, the proposal is to explore some concepts that are fundamental for any economy nowadays, such as globalization and economic development, strongly committed to each other and basically explained by the evolution driven by technological developments. In this process the location came to be an important factor that changed in times according to the technological evolution.

Also, it is important to analyse historically how the national economy has been developed, under which models, what are the characteristics that are cross-industrial and how are the manufacturing and companies' organizations culturally oriented. The models were connected to different industrial focus that need to be explored one by one.

3.1 Globalization

Understandings of globalization such as "complex connectivity" may situate globalization in recent times but perspectives on globalization such as growing economic, social and cultural changes move us much back in time [113].

A long-term process analysis puts globalization starting by 3000 BC at the bronze age and then stretched across Afro-Eurasia by 1000 BC. Another important period was the Greco-Roman world and the followed intermediary phase. Then came the milestone of 1500

with the growing role of Europe and Americas starting with the silk routes in Asia and Middle East, and the triangular trade and Atlantic exchange. The last periods of globalization took place during the 19th century, linked to industrialization process and colonialism, during the second half of 20th century and, finally, after 2000 with all new patterns for the 21st century [113].

However, assessments of the timing of globalization are commonly influenced by eurocentrism perspectives, which points to different four phases [113]: multicentric, Euro-Atlantic, globalization of the 20th century and the globalization of the 21st century. We are familiar with the new and accelerated globalization eras, starting on the 16th century with the maritime European expansion. This phase was basically motivated by the European countries' need of searching new markets and raw materials and it was permitted by the advances on over sea transportation. The world distances between countries diminished and the economic development could depend since then on diverse international resources.

A second phase started about the middle of 19th century, after the colonial domination by the Europeans in Asia and mainly in Africa, when the industrial revolution was requiring more and more raw materials, obtained in colonies, to develop the European countries infrastructures and transports.

A third phase is commonly identified with the Cold War, determined by the stated bipolarity of the world. Science and technology had dramatically advanced based on the weaponry and space competition. During this period, it was possible to develop all technological areas such as transports, communication, computers, robotics, internet or biochemistry, the so called Third Industrial Revolution. We assisted to a more worldwide integration but in different region's speeds [114].

The fourth phase have started with the fall of the Berlin wall in 1989, when the world was starting a new era of capitalism, much more technological [115]. All the countries could be connected, and the polarization of United States, European Union (EU), China and Russia are a reality that orients the international power arena. The period immediately before and after this event is particularly important for the Portuguese economy.

According to the eurocentrism perspectives, it is important to consider the mutual interactions of developing countries with advanced countries, since the moment when the western countries expanded their production in a worldwide scale, they were awakening the less-developed world to their economic development. Many stages occurred in this process, since the exchange of raw materials in colonies to be manufactured in western Europe till the manufacturing plants be placed in developing countries wherever were available the raw materials. The various development stages can be connected to heterogeneous economic interrelation, meaning that heterogenous economies have the capacity of creating complementary relationship provided that the products of one area can become the object of wants by the inhabitants of other areas. When the economic nationalism of developing countries established consumer goods manufactured with national capital and converted those industries to national capital so far operated by foreign capital, it means that a new stage of homogenization was established between their industries and the industries of the advanced countries [116]. Then we have a high-degree of homogenization, when the less advanced countries start manufacturing capital goods by themselves. The old imperialism in less advanced countries of seeking raw materials came to be gradually eliminated by their nationalism economic attitude. So, the advanced countries began to produce artificial materials by chemical synthesis and adopted activities of re-agriculturalization to be less dependent on less advanced countries, that by their side started their own industrialization process [2]. Therefore, the economic development is historically connected to the interactivity between the industrialized countries and those with raw materials and to the interdependency and evolution of the political and economic power in less advanced countries which have turned into advanced economies. The globalization effect dropped to a more homogenized economic world, where the locations are more dependent on structural, social and political environment than to the location of materials needed for the manufacturing processes.

3.2 The Portuguese Industry Transformation in the Last Decades of Twentieth Century

3.2.1 The Industrial Restructure in Portugal by the 80's.

International transactions were of paramount importance for the Portuguese economic developments during the 20th century, particularly in its second half [117]. The economic recovery in the early 30's of the last century was supported by a financial system imposed by the regimen that lead the country for 45 years up to 1974, with impressive growth rates. The main actors were important families supporting the regimen, who detained the production and financial power both in Portugal and in the colonies, acting similarly to those developments explained before when the economic growth was analysed, but in a very closed system, with low business activities out of the empire frontiers [118],[119].

The openness period to democracy after 1974, on top of the loss of ultramarine dominance, has been characterized by a deep political and social convulsion, by a worldwide economic crisis and by the increase of the international competitiveness, now much more determined by the internationalization of production and capital, and based on innovation both for new products and for the manufacturing processes. The Portuguese exportations had to be reoriented to Europe and US. Politically, Portugal asked to be member of the EU, at that time an Economic Union. This integration was fundamental to fund infrastructural reforms like transportation, to introduce financial incentives to industrial production, and to accelerate local and regional investments. All this fresh air was the base for an economic recovery in the second half of the 80's decade [120].

In terms of industrial employment, there were two groups with different dynamisms in terms of growing rates.

One group with sectors like clothing and footwear increased more than 6% in terms of employment, reflecting a sectorial specialization in volume of exportations and consequently in employment, although the competitiveness was based in low wages and where there was no modernization of the industry [120]. Other sectors as well growing

above the average in terms of employment, among 2% and 5%, were machinery, electrical equipment [121] and wooden manufacturing, which growth resulted from an increase of internal and international demand and from an active internationalization of some industrial factors, again based on low wages and with a strong weight on exportations [120]. Other industries included in this group are graphic arts and publications that have been transformed worldwide due to the improvement of transportation, allowing new localizations out of the big canthers. Moreover, sectors with low employment weight also grew, but with lower growing rates, such as beverage, plastics and leather, in consequence of the increasing of the purchasing power justified by the economic growth and by the change of consumption standards [120].

Other group with sectors with low growing rates in terms of employment were those with a weak labour dependence, like scientific equipment, photography, optics, and chemistries, and with nulled or negative growth in terms of sales volumes, such as heavy machinery, textiles, food, metallic products, paper, oil and gasoline production, glass and others. These negative growth rates are mainly explained by aspects like the sectorial specialization, change on low wages as the competitiveness advantage, due to the internal demand increase supported by the increase of the purchasing power, consumption habit's changes to more industrial products and other factors [120].

Particularly, the heavy machinery suffered the impact of the Eastern countries. The European integration and the regulating working laws, turned it less flexible to respond to international competitors. In other hand, these industries have been impacted by the capital concentration, with the fusion of important companies and industrial groups [120].

In general, the industry benefited mainly from EU programs after Portugal integration. The most effective program was the so called PEDIP (Specific Program for the Development of Portuguese Industry) [120],[122]: in 4 years (1988-1992) this program supported about 7.330 projects, allowing investments of about €4,6B, focused in the increase of the production; the big slices of the investments, absorbing above 60% of the funds were first construction and transportation materials, then textiles, clothes and leather and, finally, oil derivates, minerals, coal and foundry; moreover other areas

started to benefit from those funds, especially in sub-programs of PEDIP, such as woollen, foundry and, for the first-time, information technologies, electronic and other equipment. Generally, we can conclude that looking at the evolution of employment during this period, all the efforts for production specialization were dedicated to traditional labour-intensive industries like clothes and footwear. In other words, all the investments didn't change the vulnerability of the Portuguese economy competitiveness.

When analysing the territorial changes occurred in the 80's, it could be synthetized by four vectors. First the maintenance of production deconcentrating process, especially in the main urban centres like Lisbon. Then the evident decrease in areas where the rural exodus and the population ageing were more pronounced, like Bragança and Beja. The big advantages of surrounding Lisbon and Oporto big metropolitan areas, like Braga, Aveiro, Santarém and Leiria assumed an important preference for the localization of new industries [123]. In other hand, besides those changes above described, Portugal industrial employment distribution staid with a littoral characteristic, keeping the most dynamic industries and a high importance of local economic activity to attract industrial investors and employers [120].

3.2.2 The Internationalization of Portuguese Companies

The general model of internationalization can be explained by the Uppsala model [124], gradually growing from internal to external market where the company can externalize its activities that started originally inside the country. But some companies in diverse industries like molds, machinery and electrical products, started to be reactive to external orders and then, through a real cooperation with customers and other market actors, could develop knowledge in different levels of technology and even culturally and organizationally, being accepted as components producers of big and very exigent multinational companies. Since there was a combination of different experiences and pathways of different industries and organizations in the Portuguese industrial field, the Uppsala model does not completely explain the internationalization of Portuguese companies [124].

The need of the companies to expand sales and activities to the exterior have many reasons and motivations aligned with the economic globalization. In fact, even the internal market can motivate the external expansion when companies are in a limit to obtain competitiveness advantages and to reduce risks. The motivation is not an ambition but is mainly a survival need. In the end of the day, any company that wants to grow in a country sized like Portugal, it will need somewhen to look abroad for opportunities. This reality has been changing minds and old nationalist's principles of proudly alone, where the country believed that the economy could be almost self-sustainable, and the so called small farms and family economic organization, where production resources were not shared, and the barriers to the associative approach represented an inertia force for the country economic development [124].

According to several authors, the motivations of the Portuguese companies for internationalization were [124],[125],[126],[127],[128],[129],[130],[131]:

- To overcome difficulties in disposing of products on the internal market due to stagnation or exiguity.
- To reduce costs and achieve economies of scale.
- To increase companies' incomes.
- Desire for growth.
- Diversification of risks.
- To overcome threats of competitors.
- To use installed capacity.
- To respond to external stimuli, namely to provide customer support.

The internationalization of the Portuguese companies started with exportations but the investments of Portugal outside are an important part of this process. The investment abroad overpassed the foreign investment in Portugal from 1996 to 1998, an important period for the economy [124].

The existent studies on this matter diverge in data, but it is possible to conclude about some sectorial differences. Exportations ability of industries like marbles, textiles, clothes, footwear, electric and machinery devices, and automobiles explains the Portuguese industrial characteristics. There is both traditional (like textiles) and new (like machinery)

industries as result of the new direct investments made in the 80's and 90's with high exports orientation [124],[125],[126],[127],[124],[129],[130],[131].

The organizational dimension had no influence on that orientation, which means no differences in export ability among Small and Medium Enterprises (SME) or Large Companies. All have the same ability to export.

Those companies with affiliates abroad show an ability to reinforce their position in the markets, following the gradual development process defended by Uppsala model.

Other shapes of internationalization were possible through technical support agreements, the development of products together with customers and technological developments, where the participation of Portuguese companies in international research and development projects assumed an important relevance. The universities played an important role as partners of Companies, not only for the research and development process but also for the networking development to technology access, production and selling [124].

3.2.3 Geographic and Psychic Motivations to Internationalize

The existent studies [33],[132],[133] show a clear influence of psychic distance, where language and geographical proximity were the main influences for the exports and investment's destinations. The exportations are driven to Europe, and Spain is the first choice. This orientation is justified by the integration on the EU. However, this orientation is mainly a choice of Large Companies, which are interested in scale gains. Some industries like marbles and ceramic have a long tradition to export to US, in a dependent way, meaning reacting to ordering and not controlling the market.

In terms of affiliates the geographic orientation follows the exportation destination and commercial implantation, being the EU the main driven market. But in terms of the localization of the production abroad, EU is overpassed by other geographies, like Portuguese speaking countries in Africa, Brazil, and some North African countries. These destinations, despite being far from Portugal, means a short psychic distance attitude since the culture and language have similarities with the country.

In some cases, the destination of the commercial affiliate could be linked to a production centre destination, but normally the choice of a commercial and production destination diverges and are assumed for different reasons. These destinations choices demonstrate a lack of ability of Portuguese industry facing mature markets [124]. Some textile companies have tried Asian locations and, more recently, there was at least one successful commercial and productive experience in the East, Poland, but they are isolated investments [124].

The motivations for the internationalization explain, in part, the destinations choice and the lack of capacity to face mature markets in general. The EU integration forced Portuguese companies to compete and facilitated the exportation through the tax absence in the market. But also, there was an internal market stagnation, motivating the companies to look abroad to sell their products in much bigger markets than the Portuguese, where the scale could increase competitiveness.

3.3 Actual Reality of Portuguese Industry: The Competitiveness of Portuguese Economy

Competition policy has been fundamental to the creation of the European Single Market. Portugal integration in EU led a progressive adoption of the European Competition Law. After the revolutionary process of nationalization of Large firms in the 70's, Portugal started a re-privatization program of the same firms. First competition law dates from 1983-84 and in 2003 it was created the competitive authority. In 2012, because of the financial assistance program there was a significant review of the competitive law to empower the regulators. Markets as finance, telecommunications and energy, on top of the competition authority have independent competition regulators.

Although Portugal does not exhibit an unfavourable position in the Organisation for Economic Co-operation and Development (OECD) index of Product Market Regulation (PMR), which covers state control by public ownership and price controls, barriers to entrepreneurship and barriers to trade and investment, there are some deviation to best practices: in services and non-manufactured products Portugal have introduced

important improvements but, besides retail trade, several non-tradable sectors presented in 2008 a relatively unfavourable situation among OECD countries [134].

In the 2000-2009 period, Portugal economy had a general reduction in competition intensity. When estimated with other indicators, such as sales, Gross Value Added (GVA) and employment, the reduction of competition intensity is even worst. Close to 40% of the aggregate employment is allocated in markets showing a decrease of competition intensity [134].

The most important strategic approach for the development of the country after the regimen change to democracy, has been performed by Michael Porter [135] through a famous report about the Portuguese Economy, during the 90's, by Government request. Despite of this study and report being subject for political discussion and debate, there was a consensus about the industries that should be focused and the clustering strategy that all those industries should follow to be well succeed.

The selected industries expose here are footwear, textile, molds, wine, tourism, cork, automobile and software. The last industry in the list, for the special interest of the present research study, will be object of a detailed analysis.

3.3.1 The Footwear Industry

The Portuguese footwear industry is dominated by SME and is concentrated in a cluster located in northern Portugal (i.e. around Oporto there are about 87% of the existing footwear companies and 91% of the employees) [9]. It is considered a success case in the Portuguese economy [136].

Portugal, despite being classified in 2013 as the 46th country in the competitiveness ranking with a continuous loss of competitiveness in time, is considered as a well succeeded country regarding footwear industry and, in general, is considered as an innovation-driven country, since China and other countries still focused on the efficiency [137].

After a long period of decline until 2009, since then exports have increased 55% and the Portuguese footwear industry has grown in all the most important international markets. By 2016, Portugal exported 81 million pairs of shoes, mainly leather made, valued by

€1.9B, assuming the 10th position in the international market suppliers. About 95% of production is exported to 152 countries in five continents, having now a 3,4% market share [136].

It is evident in this market, that high shares in units means normally low shares in value, mainly determinant by the brand power of Italy, for instance, permitting high prices, and the focus on efficiency of China, Vietnam and India, with low price strategies. Apart those countries with low price and Italy with a very high price, there is a normalization of prices in the rest of the countries. Also evident is the fact of Portugal be no longer a low-price country, mean that quality is a key factor and some brand penetration is in progress [136].

However, other important indicators do not show significant improvement [137]. For instance, looking the number of patents, trademarks and Industrial designs there's a decrease over the time, which indicates low levels of investment [137]. The same happened with the upgrading process, measured by Gross Fixed Capital Formation (GFCF), machinery and software acquisitions and levels of productivity, with some rise, but levels still very similar to 2000 and showing low change during the first decade [137]. Despite the overall evaluation still not so optimistic as it could be, it is important to appreciate some important figures and strategies [135] (e.g. cost leadership, differentiation and focus strategy) followed differentially by the companies, some more successful than the others [137],[136].

3.3.2 The Portuguese Textile Industry

The origin of the textile sector in Portugal dates to the 18th century and, therefore, is one of the most traditional and oldest established sectors in Portugal [138].

Textile, like footwear, is a success case of internationalization among Portuguese industries. This industry is strongly internationalized, and this process started with the need to export and gain competitiveness in scale and due to the domestic market saturation [138],[139].

This industry, being mainly constituted by a cluster of SME located in North of Portugal (Oporto, Braga, Guimarães, Famalicão and some in Covilhã), has an important impact on

Portuguese economy, assuming 10% of the total of national exportations in value, absorbing 20% of the employment and 9% of all business volume of manufacturing industries [139].

In this case, the instability of demand and increased international competition brought by the globalization process, and the fact of this industry in Portugal being mainly constituted by SME, triggered the need of organizing new forms of production, mainly dependent on the relationships between players [139].

The SME have been contributing more to the global economy than the large firms [139]. However, SME faced deep barriers to entry in international markets, such as lack of human, financial, technological and information resources [138]. But there are also other kind of barriers like international regulations, national laws and market needs related to the singular cultures that limits the internationalization of companies [139].

The main barriers are high competition based on prices. So, these firms developed mechanisms to share ideas among competitors and the partnerships started in the personal knowledge that are established with clients that engage in informal agreements [139].

3.3.3 The Portuguese Molds Industry

The molds industry is an important sector for Portuguese economy and an exemplar case of success clustering [140]. Exportations never were below 75% of all production that is in the way to double the volume of 2008 [141]. And the importations are below the exportations levels, so Portugal have a positive balance in this industry.

The clustering of the molds industry started by 1946 in two regions: Marinha Grande and Oliveira de Azeméis, and both still influencing the business nowadays [142].

In the major region, Marinha, the cluster have origins in the glass and automobile components industries, and an organic network started to model the production. A big part of the firms, instead of growing vertically integrating marketing, design and component production, decided to stay small probably because the big automobile companies' legacy of division of labour and deep specialization. But this agglomeration on top of being performance influencer, was also important by originating the creation of

start-ups companies. This means that both perspectives are observed: the organizations reproduction with more companies in the scene and the agglomeration of economies with specialized companies that works complementary with the molds industry offering services and technologies that can help the business development [142]. The fact of about 60% of production be dependent on cars components, gives us an indicator of specialization of this sector in one hand, and the need to diversify in other hand [140].

The international demand is mainly looking for a good price/quality product. The quality is given by specialized workers developed as toolmakers since they have the knowledge to produce the product in all phases. These specialists know about all phases of the manufacturing process of one mold. In other hand, the Portuguese industry has been investing about 10% of revenues in research and development process, above OECD average, mainly in the development of computer-aided design/computer-aided manufacturing processes. This fact is a starting point to gain the confidence of customers who looks for quality and precision [140].

3.3.4 The Portuguese Wine Industry

For the wine industry, the production process and viticulture sector efficiencies are quite important to determine its success and keeping competitiveness levels. In the last decades the international wine market is getting very interesting and more exigent in terms of quality, so the competition increased in a very impressive way, especially with the new world wine countries coming on the scene [143].

The old world, mainly constituted by Italy, France, Portugal and Spain, is losing share to the new world as Argentina, Chile, US, Australia and South Africa, but both Portugal and Spain have been gaining share taking advantage on France and Italy decrease [144].

Anyway, EU keeps the leadership position with almost 50% of worldwide vineyard occupation and 65% of wine production by volume and trade. Nevertheless, the trend of EU wine domination is to decline due to shrinking margins and subsidies paid to farmers to discontinue grapes production. Strategically EU wants to promote the competition internationally, focused in traditional methods and environment sustainability [144].

Portugal is the 11th wine producer in the world and the 9th exporter in value and volume. Half of total production is exported, representing 2% of total national exportations. In EU, Portugal assumes a market share of 3,62%, with almost 600 million liters and a grape growing area of 217,000 ha by 2015. There are 14 main high-quality wine production regions. In the last decades the sector has been modernized and the market regulated to turn the industry more competitive in the global market [143].

The globalization brought some challenges and threats, and so the efficiency come to be an important factor for surviving. The production efficiency is the most important factor since the vineyard systems can reach high levels of outputs by minimizing inputs.

The Technical Efficiency (TE) of the vineyard sector can be analysed in the two ways, for a certain inputs level how to maximize the output or, on contrary, for given certain level of outputs, estimate the ability to minimize the inputs. The variables that are commonly accepted by authors are land area, labour and capital (inputs). Other variables can be also important but there is no consensus. Looking at the five Portuguese great regions of wine, in the period from 1989 to 2007 all of them improved their TE significantly [143].

3.3.5 The Tourism Industry in Portugal

In this millennium tourism is assumed as the leading economic sector in the world. For Portuguese economy, the tourism is assumed as the leader sector and the capacity to attract investments to other sectors is high. Main aspects that makes Portugal an important tourism destination is linked to climate, social peace, diversity from coastline to rivers systems, people skills for languages, gastronomy and other factors. The contribution of the sector to the GNP in 2007 reached double digit above 10% [145],[146].

The direct impact of travel and tourism in the GNP, expected for 2018, is over 15%. Adding indirect and induced impacts, tourism impact in the economy is expected to be in 2028 about 45% [146]. There is no doubt about the importance of tourism on the economy with expectations as a development and growth sector pushing directly or indirectly the rest of the economy.

Porter [135] noted the different components of tourism and that tourist satisfaction depends on attraction in the place and on efficiency and quality of the other suppliers as hotels, restaurants, shopping centres and transports. Therefore, the competitiveness of the tourism sector contributes significantly to economic development, which can be described as the result of the synergy between the natural and human factors created in the tourist destination, determined by the ability of tourism organizations to attract new visitors and increase their spending in goods and services, as well as in experiences [135], [147].

In the tourism sector, clusters have great importance in stimulating innovation capacity and competitiveness at all dimensions, regionally, nationally and internationally, but they are mainly classified according to the regions. The data show that regions have different approaches and results [147].

According to [145], the different Portuguese tourism clusters are quite heterogenous in terms of competitiveness. Generally, coastal areas are medium or high performers and the in-land regions are low performers. Contrary to what could be expected, Algarve, as the main tourism destination in Portugal and known all around the world as a tourism destination, doesn't show to have high performers clusters. On contrary, Alentejo coast, Madeira and Azores are high performers. Oporto and the North of Portugal are under developed but show good natural resources to attract visitors [145].

3.3.6 The Cork Industry in Portugal

Cork is the industry that Portugal assumed the worldwide leadership. The history started by the 19th century. Two centuries before the cork has been find as ideal for wine bottles stoppers. The Iberian Peninsula seems to be the best place for the cork oaks production. Portugal took advantage on the Spanish Civil war (1936-1939) with the Catalonian cluster weakening. At that time Portugal used to export planks, and Spain exported manufactured products. In the middle of the twenty century, synthetic products threat this industry with substitute products to the cork agglomerate. After 1980, with the entrance of Portugal and Spain in the EU, this business could see better days and Europe came to be the best importer of stoppers for the wine industry [148].

The industry of Cork in Portugal had a big anchor firm around the biggest cluster developed in Portugal in Santa Maria da Feira, named Amorim Group. This company was founded by 1922 and by 1930 the company had already 150 workers expanding in 1939 to 321 workers, controlling distribution channels and being very competitive by eliminating intermediaries, buying cork in Portugal and selling stoppers to all wine producers. Main cork trees are in the South of Portugal, but the fact of the cluster be placed in North of Portugal is linked to the Port wine producers be located in the same region [148].

Till 1999 the number of companies in Santa Maria da Feira continued to grow, which is normal in a developing phase of a cluster, but the number of employees maintained at the same level, showing the beginning of its mature phase. The cluster still living this phase, it was affected by worldwide recent economic recessions, but it is keeping this industry very resilient. The exports declined from 2004 till 2011 but they are recovering and its importance for the Portuguese Economy is remarkable [148]. The existing companies are profitable with more than 80% showing positive financial results, and 49% of the 9000 employees in this industry are specialized [149].

Cork industry exportations represents 63% of its production and are destined to more than 100 countries, 70% in Europe. The exports are mostly stoppers (wine and others) and about 26% are already constituted by differentiated products such as construction materials and decoration products [149].

The future of cork industry may be supported by its ecological contribution. Cork trees are mainly planted in Alentejo (84%) and the main cork region in the world (34%, 736k hectares) is Portugal, representing 23 % of the total Portuguese forest. The Portuguese cork production is almost 50% of the worldwide production. The cork trees in Portuguese produces 14 million tons of CO₂ and maintain the survive of 37 different mammals' animal species. A cork tree lives for 200 years [149].

3.3.7 Automobile Industry in Portugal

The automobile industry in Portugal assumes the most important industrial role in the economy. It has a significant volume of revenue, a growing GVA, a strong exports focus, a

heavy position of investment in transformation industries and a high contribution for quality employment. The number of companies involved is about 900, generating 10,5B€ in business volume, equivalent to 5,6% of Gross Domestic Product (GDP) of Portugal. The GVA reach 3.1B€, that means 16% of all GVA in transformation industry. The total impact in terms of GVA in Portuguese economy is 4,8B€. The sector exports about 98% of its production and represents 20% of all goods transactions for Portugal exportations. It absorbs 18% of all investment done in the country for transformation industry. The industry is increasingly employing 72,000 people with wages 30% above the national average with elevated qualification. The total employment impact is about 130,000 people [150].

The history of automobile industry in Portugal can be summarized in three phases [151]: the first phase of automobile industry starts in the 60's during the protectionist political period, unfortunately with no expression in terms volume of cars, components and investment; the second phase begin by the 70's when there was a Government tender for automobile producers that started a commitment with the French company Renault, in a moment that Portugal wanted to be member of European Economic Community (EEC), now EU; the third phase started by the 90's with the Ford-Volkswagen project, actually only Volkswagen, named Auto Europa, when Portugal was completely open to the market, implementing incentives to investment [152].

In 1974, Portugal had 21 automobile plants producing 101.000 units, with a large model's variety, with high inefficiency in the economic point of view, with low levels of investment and no components industry. From those 21 plants, in the end of 1980 the efficiency process reduced to only 10 plants, but to increase production almost by 50%, about 146.000 vehicles, and we could assist to the development of automobile components industry, with new technologies. The Ford-Volkswagen project introduced in the industry the skills consolidation in terms of cost, quality, delivery time and process engineering. The components industry started to be the most exporter industry in Portugal. By 1977 the project Renault resulted in two new factories, for gear boxes and for cars assembly. After the closure of Renault in 1998, the structuring role of Auto Europa increased [152]. Renault is now dedicated to components and Auto Europa is dedicated to cars assembly,

were really dynamizing the industry and the economy of Portugal, and their production is almost exclusive for exportations. From those 10 factories existing by 1980, after fusions or bankrupting, there are now five cars assembly factories (Auto Europa, Peugeot/Citroen, Mitsubishi Fuso Truck Europe, VN Automóveis and Toyota Caetano), and the respective clusters of suppliers, but the efficiency improved dramatically from 17,655 units per plant in 1995 to 32,712 units per plant in 2012 [151],[153].

By 2016 the sector produced 143,481 vehicles, 60% of those made by Auto Europa, and about 95% of all oriented to exportations. The reality of accessories market is completely different. About 90% of the market volume is made by more than 400 clustering companies that are components producers, such as electronic and automation components, chassis, tires, textiles or leather for cars [150]. Then, about 8% of the sales volume represents the contribution of 474 molds companies, which many times also supply the component itself, in spite are two different business areas. The rest of 2% corresponds to trailers and other accessories [150].

The positive aspect of the automobile industry in Portugal is the productivity, GVA per worker, of 41,726 €, above the average of 28,692€/worker in the transformation industry and to 22,577€ per worker in Portugal [150]. This productivity is increasing in accessories/components segment but decreasing in the cars assembly industry. In general, from 2012 to 2016 the GVA is increasing almost 30%. In the same time exportations increase by 16% again with more positive results in the accessories and complements segment [150]. Despite the exportations of vehicles were decreasing during the recession period, it is expected a big recovery for next years. Anyway, the accessories and components represent more than 80% of exports and it is growing at very sustainable rates [150].

3.3.8 Some Conclusions about Traditional Industries in Portugal

The main lesson over the Portuguese traditional industries experiences is that internationalization is a fundamental process for survival and for the economy growth and sustainability. Exports and its representativity in the companies' activity are an essential indicator of success and a strategic factor to grow.

The industries took some lessons for the future that are mainly linked to the business power: impose branding and own products, expand from the complement product to the final product, get focus on efficiency and diversify markets and segments through the international needs evaluation and improving relationships and confidence through clustering.

Strategic alliances result to access new markets, to face new opportunities that appear from the complementarity of companies in the same markets and to the need to create new competencies for strategic positioning. Authors point out the joint-venture as the best and safer process to SME increase competitiveness and get a robust answer to reach production and commercial goals, by keeping a great freedom of resources allocation [139].

By concentrating knowledge, institutions, related businesses, competitors and specific customers in a region or nation, some industries create the so-called clusters, allowing companies to special access, relationships, better information, location incentives and other advantages in terms of productivity and growth. The result is that the whole cluster is much more than the sum of the all parts [135].

The observed industries have common experiences as growing within clusters, introduce informal connections and gain share by differencing through quality and efficiency.

Formal and informal co-operation assume an important role in the internationalization of the industries. The formal cooperation, like joint ventures, franchises and outsourcings, defend the independence of the companies and mitigate the risk of lack of trust and confidence. But informal relationships associated to social networks are based in values such as trust, reciprocity, loyalty and commitment promoting strategies based on sharing experiences and activities to reduce risks and keep sustainability in the international market.

The location can play an important role by permitting the production to reduce costs and turn the business more competitive. The productivity of a location can be important to companies which are competitors, not because on what they compete but depending in the way how they compete. All competitors by being in a cluster will be enabled to high

technology and even being knowledge-intensive, they will compete in the way they use the tools available in the cluster [135].

This means that companies benefit in two ways by belonging to a cluster [140]: the basic operational effectiveness, since they will follow the same best practices in areas such as production processes, technologies and management techniques; and by the type of strategies and the ability to compete not only based on cost, but the possibility to develop different services and approaches to the international market that a cluster allows. This second aspect is coming to be more important in more developed economies, where rivalry must shift from low wages to low total cost. So, the efficiency must be upgraded to offer a differentiation on manufacturing process. In other words, clusters must shift from imitation to innovation and from low investment to high investment not only in physical assets but also on intangibles like skills and technologies [140].

The competitive advantage offered by clusters are linked several advantages [135]: personal relationships, face-to-face communication and individuals and institution's networking development. These may happen naturally, but frequently the cluster organization must create incentives and mechanisms to all this networking can occur in a positive way.

In terms of productivity, the access to information in a cluster flows more rapidly than inside the companies [135].

Other advantages linked to productivity comes through complementarities, such as products for the buyer, marketing joint campaigns (a visitor will contact personally different companies in the same day, for instance), a better alignment of activities that can bring more efficiency and some process changes that can occur at the same time for different companies to improve cluster participants delivery [135].

But clustering is not simple, and some situations should be controlled to defend sustainability of cluster participants, specially to avoid high dependence on a small group of customers, or when activities are too much centralized in one operator.

Based on the definition of Porter, there are different typologies of clusters [135],[140]:

- Mega cluster, when products and services satisfy the demand of the same functional area of final demand, normally using complementary competencies and explores the net relationships as the case of global digital economy.
- Regional cluster is normally an industrial cluster inside a region, repeated in other regions with the same industry, partially or totally.
- Industrial cluster is a group of connected companies of specialized products or services that benefit from acting together with more competitiveness.
- Micro cluster with locally close companies working the same industry or the same segment, being traditional, with the same know-how, or emergent, with developing competencies and technological conditions [140].

Clusters have a life cycle [148]: they start in an Emergence phase identified by local or international factors; in the Development phase, clusters show their ability to anticipate market changes on international demand or global competition; and then comes the Maturity phase, when quantitatively there is an equilibrium, with no significant growth or decrease in employees and number of companies. This is determinant for the future of the cluster. Firms can upgrade their capacity or develop new technologies and so keep the cluster alive. The cluster can be replaced by a new one with new specialties. Or the cluster disappears and no new clusters emerges [148].

3.3.9 The Industry of Software

The world is living the so called Third Industrial Revolution that is linked to the influence of information technologies development and to changes in society behaviours. The world needs to use information technologies to improve the international cooperation and reach development levels assumed by United Nations [116],[154].

All the industries, economies, companies, countries, societies, families, people are connected and depends on the software industry somehow. As more involved it is in our lives, software is coming to be more and more complex, difficult to define and analyse on its combined and integrated solutions, on its autonomy to recreate by itself, and on its responsibility to make the world to be a better place to live with sustainability by globalizing activities, regulations and policies.

When comparing software industry with the traditional industries, the development process of software has unique characteristics, since it is produced at once, have a low-cost production, it is flexible and non-tangible and have a high maintenance cost. The process is constant and cumulative, with short life cycles. The production factors are physical capital with low importance, but highly important when facilitate the mobility of the most important factor, the human capital [155].

Portugal has been gaining an international role on software, some start-ups grew very fast and get multinational dimensions, other giants in the sector are investing and placing people in the country. International events as Web Summit chosen Lisbon to meet all the world players of the sector. There is a momentum to take and learn what was well done in the past and avoid the errors already done in other industries. This is an industry that depends on quality of human resources and on economic, social and geographic conditions that a country can offer. As more big companies we have located in Portugal, stronger will be the Portuguese software industry and, as a consequence, more demand for local companies.

The main problems that can be faced by the industry of software are related to regulations of the market and the lack of business data by market segments [155].

3.3.10 Definition

Software designates a set of logical instructions that make a computer perform specific tasks that are grouped in an organized way as computer programs. This industry includes companies that have the skills to provide services related to software development.

It is difficult to define the software industry and the main challenge may be explain what its limits are. Software is complex but assumes a vital importance on worldwide people's lives.

In terms of software production, the market can be split in customized and package software [155]. In terms of consumption, the software can be personalized according to the needs of the client and it can be incorporated according to the needs of the physical capital. Also it can be categorized by type of user like the engineer, scientific, industrial,

business, customer relationship management and supply chain management software [155].

Software started to be a reality in the 60's, when it was part of the hardware and could not be sold apart. But the investment to develop software soon became to be as big as to develop hardware or even higher when computers decreased substantially their manufacturing costs. By the 70's the software industry was already independent and internationalized [156].

Nowadays, the software depends on technological expertise, ability to look for opportunities and create innovative products, devices, solutions and professional skills. Entrepreneur's personal contacts and social networks are fundamental to stay alive on this industry, not only to develop business and increase the clients list, but also to develop skills, to learn about new technologies and to fund projects [157].

In fact, the software industry is aligned with the actual times, when information and knowledge are important economy builders, increasing the contribution of knowledge intensive services to the Gross National Product, and it is completely changing the mindsets of business in the world. Differently to land, labour and capital, so important for the economic growth during the Industrial Revolution, the Technological Revolution is based on an intangible support: the knowledge [156].

In terms of value chain of this industry we can identify companies dedicated to software development and companies dedicated to consultancy, management and software trade [155]. For the first group, companies see as contribute factors, from the most important to the less important: the education of human resources, the quality, cost and safety of customer's requirements, the intellectual property rights protection, the legal, regulatory and administrative environment, the clients requirements in terms of intraoperation, the general topics of security, the financial capacity of the customers, the transports and technological infra-structure, the language and culture and, finally, the taxes and distance to customers [155]. For the other group, as they don't create software, their role is to understand the client and what software they use to accomplish a good service and add-value [155].

To maximize their profits, the software companies try to be the first to get in a market before competitors, and this is a dynamic characteristic of this sector. Companies try to commit in a fast way, as a strategy to keep competitors away of their customers. But the cost to avoid the threat to new entry is different from software producers to consultancy companies. For software companies the initial need to invest is low, mainly funded by big companies as Microsoft, SAP or Oracle. Companies who produces free software don't have barriers to entry. For those companies who produces operational software for personal computers, there is a high cost for entrance, and this is a barrier for new entrances. The consultancy companies must be certified by the same big companies or other quality certification like ISO and this constitutes also a barrier [155].

Software has been performing an important role on the modernization of Portugal in all economic and social aspects and agents. It has been fundamental on the process of innovating working methods, accelerating delivery of goods and services, decreasing bureaucracy weight and connecting people and institutions.

The areas in Portugal where there is a concentration of software companies is connected to big cities, close to universities, or in areas where industry is more concentrated, as Algarve region with a concentration of tourism industry, where the offer of software companies is saturated [155]. For the sector it was determinant the development of software specialists in universities (like Minho and Aveiro) and the research and development centres that, contrary to other industries, allowed the close collaboration between companies and universities [158].

3.3.11 Different Countries Experiences

To better understand this area, it might be important to know other software experiences in the world, from completely different countries. Two experiences are here reported from very different countries, with different environments and conditions, to know what is important to learn and what should be important to avoid in the Portuguese market.

3.3.11.1 The Brazilian Experience

The main reason for the delay of software industry internationalization in Brazil was the period of protectionism followed by the Government during the 80's [156]. All the evolution and development were due to internal high competition, but as the world is global, much of possible international technology exchange and development path was missed by Brazil [156].

The internationalization is vital for the continuous growth in a first phase of the process and for companies' survival in a second phase by developing new products and understand the evolution of the international market, essential in a globalized economy [156].

In the 90's, global competition forced Brazil to abandon the protective laws and started to treat software separately from the hardware [159],[160]. Only a few industries could show a constant and sustainable grow as software industry, keep growing even during economic crisis periods.

From 2004 to 2009 Brazil could see its worldwide market share double from 1% to almost 2%, allowing a 12th position worldwide, also growing in the same period its Latin America market share from 41% to 48%. The international potential of Brazilian software is now higher than the one reached since the quality is high and competitive. But Brazilian software companies tended not to even consider the possibility to export their products, based on a high internal demand which encourages an anti-export culture [159],[156]. Brazil software industry is constituted mainly by software services (80%), which is another barrier to export. However, the inexistent international image of Brazil as a software producer, bureaucracy, high taxation and lack of government support seems to be the more important barriers to export [156].

3.3.11.2 The Finnish Experience

During the 90's of the last century Finland reached the international leadership of high-tech trade surplus: the volume of electronics and electro-technical exports tripled, overpassing paper and metals, representing 30% of the total manufacturing exports.

Moreover, from 1990 to 1998, the exports weight grew from 5% to 20% of the total export value. Finland was the most specialized OECD country in telecommunications equipment, surpassing Sweden and Japan [161].

Of course, even with a considerable number of successful companies in the telecommunications and software cluster, Nokia role was fundamental, carrying all the Finnish market, taking a slice of 40% market share in all the cluster and employing 30 % of the 76,000 employees in the sector [161].

An important characteristic of the internalization of the Finnish software industry was the dependence of strategic partnerships for technological improvements [162],[161]: customers were very important helpers for new ideas and products, enhancing the technological development of the firms and big companies gained from outsourcing product design and problem solving. Therefore, firms could learn better to understand the market with the main partner and then should look for more clients to decrease their dependence on big customers: about 82% of companies declared having partnerships with the main customers and 84% made improvements based on their orders, revealing to have common key processes to allow the information to flow among both organizations [161].

3.3.12 The Software Industry Dimension in Portugal

3.3.12.1 The Software Clusters in Portugal

Being economically transversal to all economy, this sector is vital for any country economic development, both for the investment and for the employment areas. But as other industries, the regional concentration normally generates scale economies and brings advantages from technological to business opportunities sharing.

The concentration of software companies is linked to the big urban centres in Portugal as Lisbon, Oporto, Aveiro, Coimbra and Braga [157]. Lisbon and Oporto are the most influent clusters, the first taking the leadership of services and consultancy companies and the second on software as a product. Lisbon cluster supplies the most important

technological parks as Loures, Amadora, Oeiras and Almada, this one, very influenced by proximity with Nova Technological University, has been specialized on middleware.

Portugal Telecom, a strong telecommunications company by the 90's and first decade of the 21st century, used to play a role like Nokia in Finland, being central and subcontracting other companies that developed by partnership [157], which played an important role in the creation of the Aveiro cluster. Later, after Portugal Telecom bankrupt, the companies were so developed that transformed their entities and services and adapted to new customers, in a self-reinvention process. As a small city, Aveiro has benefited from a lower risk of human capital flow comparing to Lisbon and Oporto where mobility is easier. In Coimbra, through the university areas diversity, a high investment on research and development was made on a successful and worldwide recognized start-ups and spin-offs incubator (Instituto Pedro Nunes), which made possible to concentrate companies to supply cross sectorial markets [155].

The cultural and entertainment environment in North of Portugal has been always more intense when comparing to other regions in the country, in parallel with entrepreneurship [163]. This environment has also facilitated the creation of the first videogame in Portugal that were sold to big multinationals as Sony and Nintendo. The cooperation with international companies might motivated the creation of big producers of software and small companies able to develop and upgrade existent software [163].

After gaining recognition and being in connection with the biggest multinational companies of the sector, the cluster looks now to attract investment to face the required risk capital for this segment of the software market. The notorious recognition already obtained by the region on this segment is seen through the international projects with social dimension as the educational software developed for autism. The Government also recognizes this cluster by creating IPCA digital games Lab, to develop educational programs to develop digital games, in cooperation with Microsoft [163].

The software industry is not new but still with high demand and is technologically intensive, with growing opportunities in diverse areas. As it has no frontiers or barriers, this industry invites for a niche exploitation strategy. So, companies are multiple and

mainly small, and the entrepreneur is often the founder of the company who combined innovation with investment and created a business.

The entrepreneurship is a motivation that has been included in the educational programs of technology universities as the networking is essential for the clustering and to obtain customers.

The literature suggests that [157]: entrepreneurs that have access to a diverse network have more chances to success and survive to the start-up phase and get in the maturity phase; during the maturity phase, companies will depend more on formal networks like, banks, universities, government agencies, lawyers, to survive and keep business rolling on.

The relation between social networks and entrepreneurship is relevant since is the way how they get resources and make their business grow. The main resource obtained by the entrepreneur in the social network is innovation and scientific, technological and management knowledge, decision making support, skilled workers, market opportunities and access to funding [157].

3.3.12.2 Companies and Sales in the Software Sector

A big part of companies in Portugal is composed by SME. According to Instituto Nacional de Estatística (INE) [164], in 2008 there were almost 350,000 SME representing 99,7% of all companies in the country, employing 72,5% of active population and representing 59,8% of the GVA. The SME are distributed according the population, one third in North, one third in Lisbon area and from the last third, 70% are concentrated in the Centre of the country [164].

It is known that the software sector is splashed by micro companies (i.e. about 300,000 SME (86%) are micro companies [164]), many times constituted by only one person, so called personal company. The data of INE is based on fiscal numbers, so we have a lot of actors in this market. In spite we have been analysing the market with the INE data base, all research on the sector must follow the best criteria to reach robust data.

Following the INE there are different codes in the data base where is possible to have indicators of this sector:

- 62010 Activities of computing programming.
- 62020 Activities of computing consulting.
- 62090 Other activities related to computing and data base technologies.
- 47410 Trade and Retail of computers, peripheral units and computing programs in specialized stores.

Last data available on the INE site [164] is related to 2016 based on activity and divided by those individual (only one person) and by societies.

First, we have looked to the number and sales weight on these kinds of companies (Table 1).

	Individual Companies				Societies				TOTAL			
	Number	+/-	Sales €M	+/-	Number	+/-	Sales €M	+/-	Number	+/-	Sales €M	+/-
2016	4.129	4%	51,6	9%	5.902	7%	3.485	6%	10.031	6%	3.537	6%
2015	3.962	3%	47,1	5%	5.518	7%	3.294	3%	9.480	6%	3.341	3%
2014	3.847	-1%	45,0	4%	5.135	5%	3.201	0%	8.982	3%	3.246	0%
2013	3.881	-4%	43,4	-8%	4.881	7%	3.195	2%	8.762	2%	3.238	2%
2012	4.038		47,3		4.574		3.122		8.612		3.169	

Table1 Number and Sales by type of software companies (INE) [164]

Individual companies are not growing significantly in number but showing a better growth in sales in the last three years. The societies are more dynamic in number than in sales. In total the Portuguese market is characterized by around 10,000 companies and its value is 3,5 €B. However, despite having so many individual players, the individual companies do not show to have any representative weight in sales, reaching not more than 1% (Table 2).

	Companies		SALES	
	Individual vsTotal	Societies vsTotal	Individual vsTotal	Societies vsTotal
2016	41%	59%	1%	99%
2015	42%	58%	1%	99%
2014	43%	57%	1%	99%
2013	44%	56%	1%	99%
2012	47%	53%	1%	99%

Table 2 Sales by Individual and Societies type of companies (INE) [164]

So, the conclusion is that this market, in terms of volume of sales, is only represented by societies, in spite more than 40% of the players are individual companies.

According to the different codes of economic activity, the segments were classified as Programming, Consulting, Management Equipment and Other. Important to note that INE statistics of number of companies, since there are companies with multiple activities, only classifies the most dominant activity.

	Number of Companies												TOTAL	+/-
	Programing	+/-	%	Consulting	+/-	%	Mgmt.Equip.	+/-	%	Other	+/-	%		
2016	4.266	8%	43%	3.814	6%	38%	160	-1%	2%	1.791	1%	18%	10.031	6%
2015	3.952	9%	42%	3.593	4%	38%	162	-2%	2%	1.773	1%	19%	9.480	6%
2014	3.612	3%	40%	3.457	3%	38%	166	-2%	2%	1.747	1%	19%	8.982	3%
2013	3.518	-1%	40%	3.349	7%	38%	169	-13%	2%	1.726	0%	20%	8.762	2%
2012	3.565		41%	3.125		36%	195		2%	1.727		20%	8.612	

Table 3 Number of companies by area of activity in the sector (INE) [164]

The biggest and growing part of companies are dedicated to Programming, followed by Consulting. In other hand, looking for the business volume by activity, INE is using all activities of the companies and classifies the total sales volume. When looking to the number of companies, programming is the most growing activity in sales volume with a double-digit growth (Table 3).

3.4 Conclusion

The companies of software and information technologies services have been well positioned, according international standards.

In the last reported ranking of 5000 European companies, a rank that takes in account subjects as the volume, the growth and the innovation, among the included list of 110 Portuguese companies there are 20 of software industry [165]. Among these, three (i.e.

Decksill, Yunit Commerce, and Aptoide) were classified in the first 500 positions of the European rank.

Following the literature [155],[158], the main strengths of the software industry are: high level of qualified employees, software skill to dynamize the economy, and the skills of Portuguese people concerning other languages.

Moreover, the software industry presents several weaknesses, including the small size of the Portuguese economy, geographical peripheral situation of the country inside EU, low ambition to position national brands internationally, low association of risk capital and absence of a big company as a reference for the international market.

The main tendencies of this industry will be the automation and agility of the software development models, the increase of market regulation, decentralization of development and consultancy software services, more software service and less software product, growing power of software for mobile platforms, expansion of free software and more participation of clients and user in the software development process [155].

4. Methods

As explained in the first chapter, this research study aimed to determine how the software companies are preparing their entrance in the healthcare global market. Therefore, it is important to know how the software producers are distributed in terms of company characteristics, how can be healthcare products segmented by targets, users, local to be used and objectives, and if healthcare software industry present similar characteristics to those Portuguese industries that are successful in the global market.

The review of technological solutions and health market characteristics guided us to perform a survey supported by a questionnaire. The questionnaire was submitted to a focus group to evaluate how consistent and effective could it be and what would be the best way to execute the research and development.

The orientation of the questionnaire was to identify and characterize the industry, evaluate the production of software for healthcare and analyse the level of success the Portuguese companies were prepared to reach in the coming times when healthcare is a central opportunity for the world development.

Finally, the collected evidence has been used to define possible actions to develop healthcare software in Portugal.

4.1 Success Factors for Healthcare

The Portuguese economy, as many others, is dependent on exportations to grow. The internal demand is also critical, but without gaining international scale, the competition ability will not be enough to keep the economy growing.

The Bank of Portugal is an important and determinant institution to consult and predict the main drivers of the economy. In a recent report with projections for the Portuguese Economy 2017-2019, the Bank of Portugal sentenced about a good future for the future based on a strong growth of exportations, with higher influence on Gross Domestic Product (GDP) growth [166].

This macroeconomic environment can be used by the software industry in general, having noticed that exportations are the most important driver of the economy. But it is important to add also some critical success factors for the future of healthcare, since this can be fundamental in the strategic point of view, especially for the segment we are analysing. The consultants have identified ten success factors for the future of healthcare that may be important for the role of software producers for this area [167]:

- **Indispensability:** a healthcare system must make itself indispensable with an offering that healthy community residents, patients and payers cannot avoid or go around.
- **Reinvent patient experience:** work with patients to reengineer core patient processes to leverage technologies and drive dramatically better patient engagement and experience. There is a major distinction between understanding the role of the patient in healthcare and working with the patient to redesign healthcare.
- **New revenue cycle:** develop a highly effective, productive and efficient (i.e., simplified) revenue cycle.
- **Diversified, yet integrated specialization:** optimize physician network with strong physician leadership, collaboration, diversity of specialization and alignment.
- **Mindset of well-being:** creating a mind-set for patient care that looks from a broad view of the overall patient's health and well-being across a continuum of care.

- New horizons: expand patient care beyond physician-centered and acute-hospital-located care delivery.
- Embedded innovation: embed in the organization a competency for creativity to continually innovate and rapidly execute innovation and change.
- Leveraging new technology: establish a strong capability and capacity to leverage information technology, including but not limited to mobile and web technology.
- Transformational leadership: leaders must be able to envision and execute on new, unprecedented futures while being highly skilled in the interpersonal skills needed to collaborate with physicians and care providers and to support and encourage creativity while maintaining discipline.
- Culture of responsibility and accountability: to drive demonstrated value, both patients and providers will need to operate at higher levels of accountability. Organizational and clinical culture, processes and structures must be organized to institutionalize accountability and responsibility.

Societal and demographic changes, together with economic challenges to fund healthcare are moving the way how healthcare is delivered. Growing and older populations and technological and medical advances require inevitably the development of healthcare provider's capabilities to deliver safe and quality care. These evidences are rising the need to develop more Smart and Connected Health (SCH), to manage healthcare through software solutions [168].

In other hand, it is important to have a notion about what are the areas where these solutions may have more impact, taking in consideration the development of chronic diseases and the ageing of the population [36],[169].

Following the process of design thinking to identify healthcare needs and how they match with software requirements, phased in five steps: empathizing with users, defining different software solutions, ideating good SCH solutions, prototyping ideas to tangible forms and testing to measure the effects of SCH, it is identified a list of 10 Key Success Factors (KSF's) [168]:

- Innovation champions: with ability to identify SCH opportunities, measuring the impact, empathizing with decision makers and influencing the political implementation over institutional and personal resistances.
- Clear definition of success: all staff members must understand the objective to contribute for the achievement.
- Human-centric healthcare needs and software adoption: this reduces the risks associated with developing products unfit to the market. SCH must address real healthcare needs, based on evidence.
- Knowledge and healthcare end users: knowing the healthcare provider's views, attitudes, perceptions and interactions is critical to the success of SCH innovation.
- Software team and healthcare project management: a plan must be followed, timely reported and clearly identifying key resources and software quality milestones.
- Evidence-based healthcare value co-creation: SCH must be tested and demonstrate the value delivered, as more extensively as possible.
- Infrastructure and interoperability: these are key factors regarding the adaptation to other systems in place.
- Software and medical device (regulation and statement): to assure patients that their data is secure and encrypted and can be safely transferred and stored. SCH developers must be compliant, know the rules of the game for the SCH innovation process.
- From smart and SCH data analytics to knowledge: a) to ensure that SCH meets patient's requirements, improves the quality and safety of care and empowers people to manage their own-care and well-being and b) the captured data by different SCH must be accurate and calibrated.
- Software-driven educational experiences: the SCH developers must learn how their solution influences behavioural change in patients, and how they embrace it as part of their everyday lives.

Consultants are prognosing on this market and see great opportunities for the next future [170], [171].

4.2 Success Factors for Software Industry

As referred in the chapter 3, all the well succeeded Portuguese industries passed through a process of internationalization with high focus on exportations that came to be the destination of most of the production. To get there, companies organized in clusters, strategically invested on brand power, went in the pathway from complements to the whole product, get focused on efficiency and diversified the external markets destinations. Clustering develop more informal relationships, increase confidence among partners, make strategic alliances and share services. The location can assume an important factor to develop a cluster in any industry.

The market of software is mainly constituted by Micro and Small Medium Enterprises (SME), as all the other Portuguese industries, and the chances of the survival and growth of these companies, to access the international markets, to coopete among them, can pass through being part of a cluster.

By knowing the importance of clusters in the Portuguese economy we must to have the perception if the companies producing healthcare software, particularly SME, are able to be part of a cluster and how the sector is organized. The companies must integrate the success factor for the industry with the success factors for healthcare. The understanding of both factors can be a reflex on companies' exportations activities and production of software for healthcare. So, basically, we must evaluate if the industry is focused on exportations and if the companies are aware about the opportunities in the healthcare market, as the chronic diseases monitoring, active ageing support or patient's big data.

Moreover, we must evaluate in which terms the SME may develop their ability to export. If exportations are determinant to make the economy grow, they may also be important for the most important agents to grow. But SME, to grant future sustainability, must be innovative, otherwise their life expectancy will be low or at least, they will live in uncertainty and with low investment power among funding sources. More than being intuitive, there is a lot of evidence about the vitality of exportations and trough the innovation, each one is determinant for the success and survival of SME.

By participating in international markets, firms promote their learning and so their innovation performance. And trough innovation firms are likely to enter in different

geographical markets, therefore making exports more successful. Also, with this binomial, they will be able to improve quality and will also be able to grow domestic sales [172].

The positive effect of innovation for companies' business growth is higher when they also create exportations strategies, and vice versa. So, the adoption of one growth strategy positively influences the adoption of the other [172].

SME may have to benefit of three key success factors: innovation, exportations and the effect of both being together.

4.3 The Questionnaire

To better understand this market, first it was important to use all the available information. Carlos Marçalo (editor of *Semana Informatica* magazine) who used to publish a list of 200 companies with data such as sales, exportations, number of workers and growth rates from one year to another could help with a first view of the market. This magazine stopped editing by 2014, but the editor could be very helpful to determine representative data intervals where companies could be classified and to define the areas to approach in the questionnaire. Following his experience, the criteria to elaborate the questionnaire was to use data intervals and multiple choice instead of open answers to avoid company identification and facilitate the participation of a maximum number of companies.

After an introduction where the objectives of the survey and all the sponsors are referred, the first part of the questionnaire includes an extensive characterization of the companies through sales dimension, type of business, economic activity, kind of distribution, healthcare products weight, the exportations dimension (weights on sales, of healthcare products and destinations), and through a human resources picture on number, genders, literacy and managers experience abroad.

As the literature suggests, the perception of the management about the reality and how do they prioritize different aspects, it is determinant for the strategy they follow. The questionnaire pretends to evaluate how are the managers in Portugal perceiving the opportunities when faced to real global facts and create a monographic understanding.

The second part of the questionnaire evaluates determinant factors to develop a strategy to target the healthcare software solutions market.

The third part is focused in evaluating the success factors to export software products according to software producers.

Finally, the fourth part includes a suggestion of healthcare software products segmentation classified by target, products objectives, local to be used, interaction, orientation and criticality. This suggestion has been reached through the literature review developed in the second chapter on technologies to support healthcare and ageing.

4.4 The Focus Group

A first draft of the questionnaire was submitted to a focus group chosen among different experienced academic, research and industrial people. The group analysed the questionnaire in a session organized by the investigator and his PhD supervisors, Nelson Rocha, PhD, Full Professor, and Alexandra Queirós, PhD, Coordinator Professor, both from the University of Aveiro, and took place in the facilities of Fraunhofer Association in Oporto. The invited group was constituted by the following people:

- Luís Almeida, PhD, MD, founder and Managing Director at Blueclinical Ltd. President of the College of Clinical Pharmacologists, and Affiliated Professor of Oporto University.
- Carlos Alves, co-owner of an electronic component's factory (HFA).
- Filipe Sousa, researcher in Fraunhofer Association.
- Pedro Pinto, CEO at Body Interact Inc, US.
- Bruno Gago, PhD, Deputy Director - Training Program in Pharmaceutical Medicine at Unave, University of Aveiro.
- Inês Joaquim, economist of the Health Economics Department in Medtronic, worldwide leader in medical devices.
- António Murta, investor and owner of Pathena technology Fund (absent).
- Joaquim Cunha, Executive Director of Health Cluster Portugal and owner of CASO, a software consultancy company.

All the session was videotaped, and all presented elements were very active by giving differentiated feedback that helped to optimize the questionnaire.

4.5 The Survey Execution

To reach a robust sample we should cover a high number of companies and get them through different approaches. The “Associação Portuguesa de Software” (ASSOFT), the Portuguese association of software companies, helped with the list of their associates’ contacts. That associates list represents about 90% of the total software producers market value, according to the President of that institution, Mr. Luís Sousa. A list of more than 400 different companies received an email from ASSOFT President, inviting all companies to participate in the survey through a link created by Universidade de Aveiro. Once the email approach, especially when targeted to software companies, could be impacted by firewalls and spam systems installed by these companies, a second approach has been developed through a phone survey company. The author selected, following good references, a company named Pluricall, which abled a group of graduated and experienced surveyors selected by a company manager, Mrs. Susana Silva, and trained by the author to make the questionnaire on phone. The contact list was the same as used for email, enabled by ASSOFT, and numbers were aleatory called through the company management calling system.

4.6 Data Analyses

Following the questionnaire, the results were measured as more fragmented as possible, since there was statistically significance in each group and cross analysis. Taking in consideration that the sector is massively constituted by micro companies, but the business volume is more concentrated in small, medium and big companies and assuming the companies are transforming very rapidly, the author opted to analyse the groups independently of their fiscal definition but taking in consideration common characteristics.

5. Results

5.1 The Sample

Following the principle that the importance of a company in the market is mainly determined by the sales volume, we can conclude that the software producer's companies in Portugal are mainly micro companies following the economic characteristics of Portuguese companies.

According to the European Union' (EU) recommendations, the companies are classified as Micro, Small, Medium and Large following criteria of Sales Volume and Number of Employees. There is also an accounting element of net Balance. Considering the Sales Volume and number of employees, a Large Company may have sales volume at €50M and €250 or more employees.

The rest of the companies are classified as Small and Medium Enterprises (SME) where we find Micro, Small and Medium Companies:

- A medium company may sell annually less than €50M and employ less than 250 people.
- A small company may sell annually less than €10M and employ less than 50 people.

- A micro company may sell annually less than €2M and employee less than 10 people.

As employees in this market are often variable and temporary according to companies' activity level, in this study companies were only classified following the Sales Volume criteria.

The major activity is done by companies who are associated in ASSOFT. The list of associated companies submitted to our questionnaire corresponds to 435 contacts which, according to the ASSOFT administration, represents about 90% of total programming market in terms of sales volume. By collecting 104 questionnaires with sales volume, from which 97 questionnaires were completed, our sample represents 23,4% of the ASSOFT associate's list of 435 companies, which means roughly 20% of the Total Sales Market of software producers.

The sales volume stratification in the questionnaire has been grouped following the sales volume classification for Micro, Small, Medium and Large Companies (Table 4).

Company Type	Sales Volume	Number	%	National Prevalence
Micro	0-2	71	68,3,0%	85,6%
	2-3	6		
Small	3-5	4	12,5%	12,2%
	5-10	3		
Medium	10-20	8	10,6%	1,9%
	20-40	3		
Large	40-80	3	8,7%	0,3%
	80-150	3		
	150	3		
TOTAL		104	100,0%	100,0%

Table 4 Sample according size and sales Volume vs National Prevalence of companies' size

The Large and Medium Companies have a special prevalence in this industry, showing different predominance when compared with the national Large Companies panorama. Nevertheless, the software Micro companies are significantly dominant in number, following the country general industrial characteristics.

Taking the mid-points of the sales intervals presented in the questionnaires, this group of 104 companies, that we know are programming software but also consulting, managing equipment and doing other activities, have sales of €1,6B, equivalent to 46% of total market value of €3,5B. That means this sample may not be not only representative among those companies of software but also highly representative of all market.

About 70% of sales are made by Large Companies, which in number are less than 10%. About 30% of software companies are somehow developing healthcare solutions.

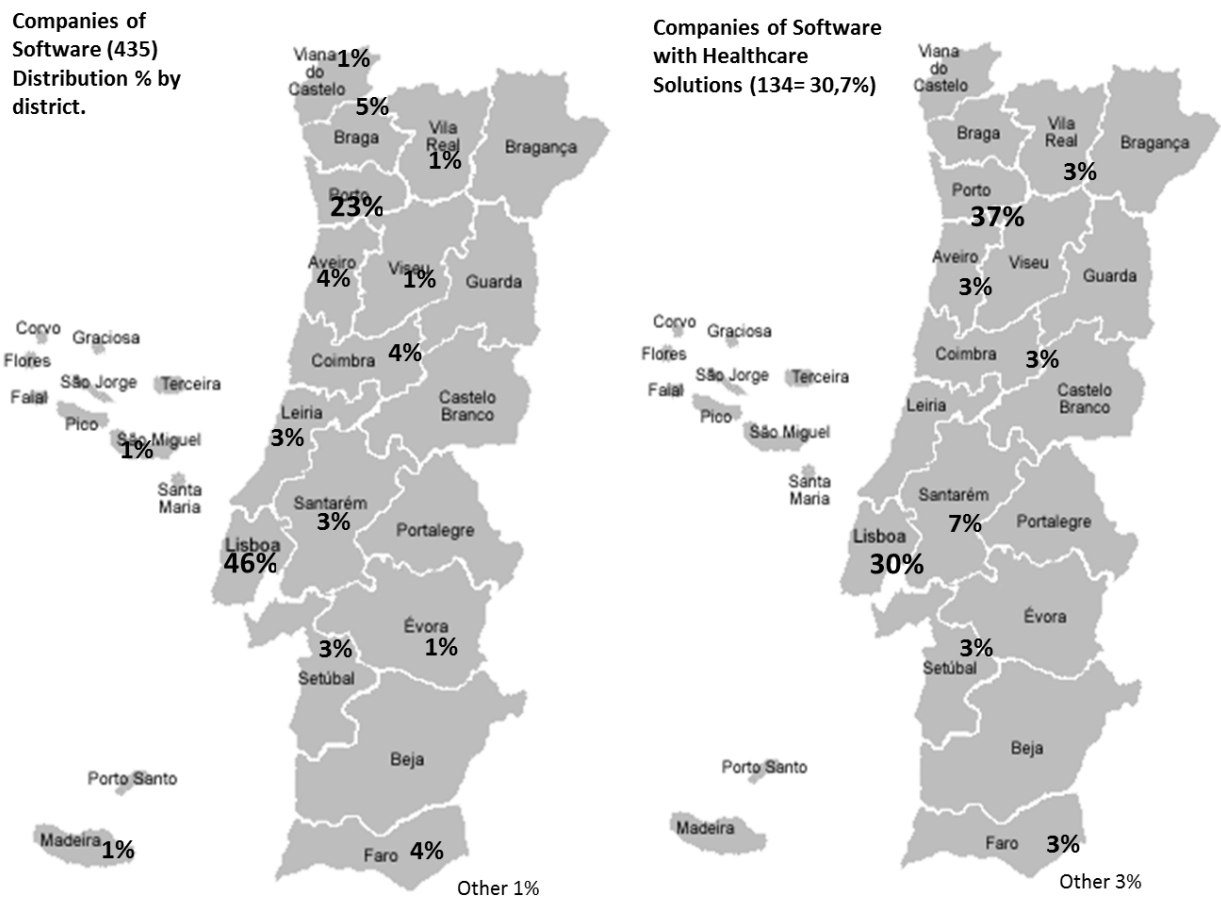


Figure 1 Location of software companies and those with healthcare solutions

5.2 Location

As other industries, the software companies are mainly fixed in urban and coast side population centers. The big cities as Lisbon and Oporto concentrates almost 70% of all

companies (Figure 1). Those with healthcare solutions are also concentrated in two big cities, but Oporto have more companies focused on healthcare than Lisbon.

When analyzing the four big districts, Lisbon, Oporto, Coimbra and Braga, the concentration of software companies is mainly around or in the big cities (Figure 2).



Figure 2 Software companies' locations in the different Portuguese regions

The distribution of companies in Lisbon district is like the general services and industries distribution, following the Tagus river line. Almost 50% of the total number of Portuguese software companies are in this district.

The big companies are mainly located in Lisbon and Oporto, but Oporto receives the major part of both Medium and Large Companies. More than 50% of the small companies are in Lisbon.

5.3 Human Resources

Human resources are the main production factor in the software industry. As average, the software companies employ around 30 people each, 34% are female and 66% are male. In terms of education, we find that 51% of employees are graduated and 14% have a PhD. The results about life experience around the world show that 2% of employed people by Portuguese software companies are foreign employees and managers who leaved abroad at least 1 year are about 2,5%.

HR aspects	Type of Company							
	Micro		Small		Medium		Large	
	Average	SD	Average	SD	Average	SD	Average	SD
Head Counts	18,4	33,5	25,2	15,4	87,2	95,8	93,3	141,4
Female %	33,2	25,7	31	17,7	36,6	11,3	41,1	29,6
Male%	66,4	25,4	69	17,7	63,4	11,3	58,9	29,6
Graduated People%	54,5	36	31,9	37,1	59,1	36,3	56,8	34,1
Employed PhD%	19	25	15,3	27,5	9,9	5,9	2,5	0
Foreign employees %	0,8	2,5	0,5	2	12,1	16,9	2,5	5,9
Living abroad 1 year	2,4	1	2,3	0,8	3,3	1,6	2	-

Table 5 Human Resources by companies' size

The results suggest that Large Companies, defined only according to sales volume, shows a big deviation on the number of people (Table 5).

There is a higher concentration of female collaborators in larger companies, where the gender balance is normally a strategic concern (Table 6). Also, the foreign employees are more presented in larger companies once their international environment is more frequent (Table 6). The employees with PhD are more common in smaller companies,

suggesting that companies are startups born with academic thesis-based products and solutions.

Companies Size vs number of Managers experience abroad

	0	1-2	3-4	5+	Total
Micro	40	19	4	1	64
Small	7	5	1	0	13
Medium	2	4	2	3	11
Large	4	1	2	2	9
Total	53	29	9	6	97

Table 6 Managers experienced abroad distribution by companies' size

The graduated people are likely to show no big differences according to companies' size. But size seems to be related to managers' experience abroad.

The most important countries' comparison factors showing some or many differences for all companies were economic level, per capita income, purchasing power, language and cultural values and, finally, the beliefs, the attitude and the tradition. Those factors were indicated always by above 40% of the companies' managers who lived abroad.

Factors as economic level, per capita income, purchasing power and beliefs with some and many differences were important for companies with one or two managers living abroad.

Those companies with three to four managers living abroad shows that the countries where their managers use to live were like Portugal in terms of technical requirements, market competitiveness and lifestyles. On other hand, they show many or some differences in legal regulations, per capita income, literacy and education, and language.

Companies with more than five managers living abroad refer their managers lived in countries with some or many differences in the following aspects: market competitiveness, legal regulations, per capita income, purchasing power, lifestyles, literacy and language.

5.4 Business, Property and Distribution Aspects

The results about property patents suggests a very high-patented items rate on this market (Table 8). Relatively to this subject, more investigation is required to identify and differentiate international and national patents. The business orientations originated by the customer and coming under licensed products is mostly divided by 50/50 with a tendency to be more likely originated by customer as the company size increases.

In terms of distribution the market preferences to follow a direct distribution and avoid contracting exclusive distribution. There are no indicators showing big differences on this aspect according to the type of the company (Table 7).

Business, property and distribution aspects	Type of Company							
	Micro		Small		Medium		Large	
	Average %	SD	Average %	SD	Average %	SD	Average %	SD
Bus. Orig. by customer	51,6	40,4	50,5	41,5	38,3	36,6	61,1	43,7
Bus. under licenced prod.	48,4	40,4	49,5	41,2	61,7	36,6	38,9	43,7
Total control	100	-	100	-	100	-	100	-
Products patented by company	46,1	50,1	49	51,7	66,7	51,6	55	49,9
Prod. Patented by custommer	5,7	22,5	19,1	40,1	0	0	0	0
Not Patented products	46,6	49,8	61,5	50,6	100	0	76,7	40,8
Total control	98,4	-	129,6	-	166,7	-	131,7	-
Direct Distribution	70,6	39,1	79,4	32,2	65,3	37,8	78,9	33,7
Diverse distributors	16,1	29,7	11,3	28	24,1	35	14,4	24
Exvclusive distributors	13,3	30,2	9,3	21,2	10,6	24,4	6,7	13,2
Total control	100	-	100	-	100	-	100	-

Table 7: Business origin, property and distribution aspects of software companies in Portugal

5.5 Exportations

The level of exportations of this sector is not as significant as other important industries in Portugal. On the other hand, the weight of products related to healthcare is higher on

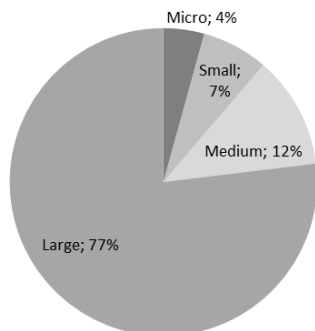
Large Companies, suggesting that all national healthcare companies and suppliers are good consumers of software. In terms of total value of this market, exports represent 32,5%, considering mid points in both intervals of sales and exports percentages declared by companies on the questionnaire. About 36% of the companies declared to have no exports, so, in Portugal, about 64% of companies are already linked to international market somehow. But the Large Companies, that represents only 10% of the companies, exports about 77% of the total exportations of this industry. The Micro companies, that represents 66% of all companies, are only responsible for about 4% of the total exportations. The Small and Medium companies are responsible for 20% of total exports (Table 8). About 63% of the companies export less than 10% of their sales volume. And from those, 70% are Micro Companies and 21% are Small and Medium (Table 8) (Figure 3).

Total Exports vs Sales Volume/Company size

		Companies Size										
		Micro	Small		Medium		Large			Total	%	
Mid Points		1,0	2,5	4,0	7,5	15,0	30,0	60,0	115,0	150,0		
Sales Volume €M		0-2	2-3	3-5	5-10	10-20	20-40	40-80	80-150	plus 150		
% Exports	0,0%	25	1	1		3	2	1	1	1	35	36%
	2,5%	9									9	9%
	7,5%	9	1	3		1	1	1			17	18%
	13,0%	2	1							1	4	4%
	18,0%	1				1	1			1	4	4%
	25,5%	5						1			6	6%
	35,5%	4	1		1	1	1				8	8%
	45,5%	2									2	2%
	70,5%	3			1						4	4%
	90,5%	4	2		1				1		8	8%
Number of Companies		64	6	4	3	6	5	3	3	3	97	100%
		64		13		11		9			97	
Exports Value €M*		10	6	1	9	9	18	20	113	47	232	
		10		16		27		179			233	
		4%		7%		12%		77%				

Table 8 The exports dynamic of the sector, by companies' size

Exports by company size group



Percentage of companies by percentage range of Exports

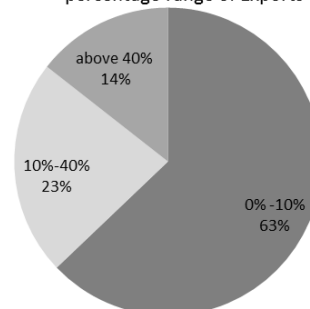


Figure 3: Volume and number of exporters of software companies in Portugal

Although there are companies looking to markets such Oceania, North America and Asian countries, the main destinations for the exportations are Portuguese speaking African countries (PALOP) and Europe. So, as the volume of exportations is not a driver of this industry this analysis focused in the observation of percentage of companies who have commercial relations with each destination (Figure 4).

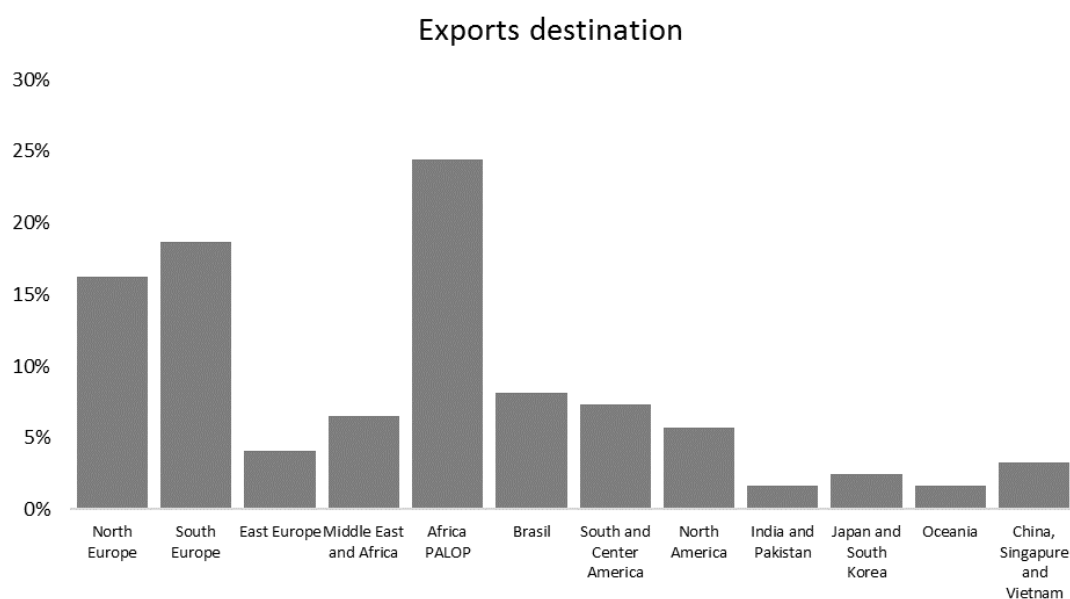


Figure 4: Exports destinations of software products in Portugal

On other hand, taking in consideration the percentages used by responders to classify their exportations level to each destination, about 50% of those companies are exporting high or small percentages to each destination. Also, following the answers, there were an average of less than two destinations by company, in other words, a low diversity of destinations for the exportations of the companies in this industry.

5.6 The Healthcare Segment

On top of Large Companies being the more exporting companies, they also have more healthcare products. But the capacity to export these products seems to be much inferior to the ability to export other products (Table 9).

Exportations	Type of Company							
	Micro		Small		Medium		Large	
	Average	SD	Average	SD	Average	SD	Average	SD
Exports as % of sales volume	19,4	29,1	12,6	19,5	13,3	13,4	30	37,3
Weight % of Helthcare products on Total sales volume	13,6	29,3	29,7	41,9	16,9	28,3	65,1	39,2
Healthcare products exportations % on Total sales volume	5	17,2	13,4	28,9	1,7	2,5	28	38,5

Table 9: Exports and healthcare products of software companies in Portugal

The data about exports destinations suggest a non-global psychic distance of our entrepreneurs, very influenced by the country inclusion in EU and by the close relationships between Portuguese speaking countries and Portugal. From the results only three companies were exporting healthcare products to Europe and African Portuguese speaking countries. The volume is not significative.

5.7 Software Industry Targeting Healthcare Market

There is a radical option to classify factors to target healthcare market. Companies clearly concentrated their quotes as low (1) or middle/high rates (4 to 6) (Tables 10 and 11). In general, all factors were high important for healthcare and 6 was the most voted quote to classify all factors. Nevertheless, chronic diseases and population ageing are the most important factors to target healthcare by software producers in Portugal (Tables 10 and 11).

Strategic key factors to target Healthcare market							Total control
From 1-Low to 6-High importance	1	2	3	4	5	6	
a. Chronic Disease impact	25	4	7	13	17	31	97
b. Ageing Population	19	2	7	10	28	31	97
c. Mobile Phones Market	16	7	14	16	22	22	97
d. Smartphones by Healthcare professionals	18	1	14	14	21	29	97
e. Mobile health (mhealth) market	23	2	10	17	22	23	97
f. Healthcare expenses	18	1	8	19	24	27	97
g. Digital Literacy	12	4	9	24	23	25	97
h. Evidence of innovation	9	5	6	20	27	30	97
i. Electronic Health Records	17	2	4	13	27	34	97
j. Personal health records	17	4	3	17	27	29	97
k. Well-Being technologies	18	4	5	23	22	25	97
l. Health literacy	21	2	13	26	17	18	97
TOTAL	213	38	100	212	277	324	

Table 10: Evaluations on opinions to produce healthcare products

Strategic key factors to target Healthcare market							Total control
From 1-Low to 6-High importance	1	2	3	4	5	6	
a. Chronic Disease impact	26%	4%	7%	13%	18%	32%	100%
b. Ageing Population	20%	2%	7%	10%	29%	32%	100%
c. Mobile Phones Market	16%	7%	14%	16%	23%	23%	100%
d. Smartphones by Healthcare professionals	19%	1%	14%	14%	22%	30%	100%
e. Mobile health (mhealth) market	24%	2%	10%	18%	23%	24%	100%
f. Healthcare expenses	19%	1%	8%	20%	25%	28%	100%
g. Digital Literacy	12%	4%	9%	25%	24%	26%	100%
h. Evidence of innovation	9%	5%	6%	21%	28%	31%	100%
i. Electronic Health Records	18%	2%	4%	13%	28%	35%	100%
j. Personal health records	18%	4%	3%	18%	28%	30%	100%
k. Well-Being technologies	19%	4%	5%	24%	23%	26%	100%
l. Health literacy	22%	2%	13%	27%	18%	19%	100%

Table11: Key factors to produce healthcare products

The Evidence of innovation seems to collect consensus among producers, classified with high importance. Many factors have been polarized on very low or high importance. Electronic Health Records (EHR) reached a maxim preference of 35% on very high quote (4 to 6). The factor that reached the lowest importance rates was Chronic Disease impact, while was considered as one of the most important, showing polarized opinions. Generally, high quotes (from 4 to 6) were given to all factors with totals from 60% to 80% (Table 11).

5.8 Factors to Export

Contrary to the success factors to target healthcare, the companies had not radicalized their opinions for exportations, but factors were mostly quoted as important or very

important (5 and 6). More than 80% of quotes were positive to all factors. Clearly, companies agree that low wages in Portugal is not considered as an important factor to export. More strategic factors such as Client followership, Strong human capital and a National approach are high important to succeed on exporting (Table 12).

Success Factors for Exports									
From 1-Low to 6-High importance	1	2	3	4	5	6	✓	Total control	
a. Influence of Government vision...	12%	4%	11%	23%	23%	27%	✓	100%	72%
b. Strong Human Capital,... Universities...	9%	0%	5%	21%	29%	36%	✓	100%	86%
c. Take advantage on life quality in Portugal...	6%	2%	8%	24%	26%	34%	✓	100%	84%
d. Low wages in Portugal...	25%	18%	21%	23%	7%	7%	✓	100%	37%
e. Clusters to find international customers...	6%	2%	9%	18%	35%	30%	✓	100%	82%
f. Domestic capital availability	5%	2%	8%	24%	38%	23%	✓	100%	85%
g. Technological infrastructure... startups...	3%	8%	7%	22%	31%	29%	✓	100%	81%
h. Linkages...cultural...linguistic...diaspora...	4%	2%	18%	30%	26%	21%	✓	100%	76%
i. Client followership.....	4%	3%	4%	21%	33%	35%	✓	100%	89%
TOTAL	8%	5%	10%	23%	27%	27%	✓	100%	

Table 12 Success Factors percentages to export software products

5.9 Healthcare Products Segmentation

According to the answers, 64% of total companies seems to have no healthcare product to target. The rest 36% have at least one product and responded to the questionnaire accepting the proposed six segments to quote their products: target, purpose, local to be used, interaction, orientation and criticality.

Segmentation health products by target		
Number Products	Number Companies (at least 1 product)	Average by Company
Caregivers	49	29
Patients	24	19
Chronic Patients	25	19
Eldery	25	17
Total	123	31

Table 13 Target segmentation of healthcare products developed by software industry

The more targeted segment is the caregiver and there is a lack of focus on the tendencies related to the patient’s empowerment and the elderly markets (Table 13).

The most common purposes are the health control and diagnose data bases (Table 14). Education and community care are still not focused by software producers to target their products.

	Segmentation health products by purpose		
	Number Products	Number Companies (at least 1 product)	Average by Company
Individual	31	19	1,6
Health Control and Diagnose	47	22	2,1
Education for HealthCare Professionals	24	15	1,6
Database	45	21	2,1
Comunity Care	29	18	1,6
TOTAL	176	29	6,1

Table 14 Purpose segmentation of healthcare products developed by software Industry

Home use is considered less important than mobile solutions, following the tendency of the market, connected to mobile hardware growing usage (Table 15).

	Segmentation health products by local		
	Number Products	Number Companies (at least 1 product)	Average by Company
Indoor and outdoor	63	32	2,0
Home	33	18	1,8
TOTAL	96	34	2,8

Table 15: Local to be used segmentation of healthcare products developed by software industry

A significant number of the companies with healthcare products seems to have developed interaction with other software or hardware solutions (Table 16).

<u>Segmentation health products by interaction</u>			
	Number Products	Number Companies (at least 1 product)	Average by Company
Adaptable to health condition	57	30	1,9

Table 16: Segment of interaction of healthcare products developed by software industry

<u>Segmentation health products by orientation</u>			
	Number Products	Number Companies (at least 1 product)	Average by Company
Self-healthcare	22	16	1,4
Assisted healthcare	26	16	1,6
Supervised healthcare	47	26	1,8
TOTAL	95	30	3,2

Table17: Orientation segmentation of healthcare products developed by software industry

In terms of orientation, the healthcare products in this market are made more to be used by healthcare providers than by the patients (Table 17).

Finally, in terms of critically, it is noted an alignment with caregivers instead of Chronic Patients and Elderly needs increase of Rescue solutions (Table 18).

<u>Segmentation health products by criticality</u>			
	Number Products	Number Companies (at least 1 product)	Average by Company
Rescue	26	14	1,9
Mobile workforce, safety....	47	26	1,8
TOTAL	73	27	2,7

Table 18: Criticality segmentation of healthcare products developed by software industry

5.10 The Producers of Software Healthcare

So far, the analysis of the results has been focused on how the software industry is oriented in different aspects as exports, property, distribution, human resources, and targeting healthcare according to the size of the companies in the National territory. Also, the results indicate tendency of the location of companies and it is possible to localize those companies producing healthcare solutions. Following the evidence of the importance of clustering as a key strategy to develop a specific market as software for healthcare, it is important now to observe results according to this specific segment and then how are those features seen in the different regions where those solutions are produced.

The companies that produces healthcare solutions have a total share of 32 % of total market and 21% of their sales are related to healthcare. All this software for healthcare production is massively dominated (83%) by Large Companies, which are mainly multinational companies. The part of exports that is dedicated to healthcare sector represents 5% of the total exportations, and less than 1% of total market sales of those companies who produce healthcare solutions, consequently with no expression on total market (Figure 5).

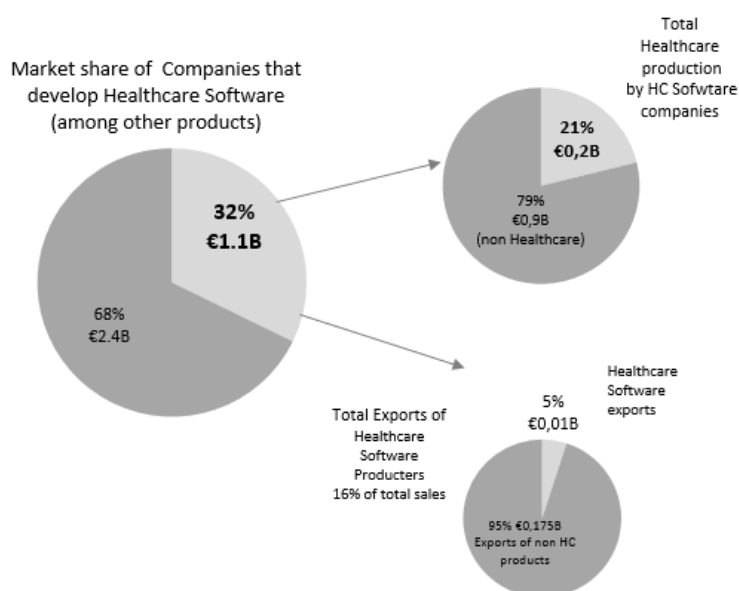


Figure 5 The weight of software for healthcare in the total market

When compared to other industries with high percentage of exportations, the conclusion is that the software industry with 16% of total sales as exports is not focused in the international market. Also, the production of healthcare products represents only 5% of total market, so there's no specialization on this segment (Figure 6).

Total market, healthcare products and exportations

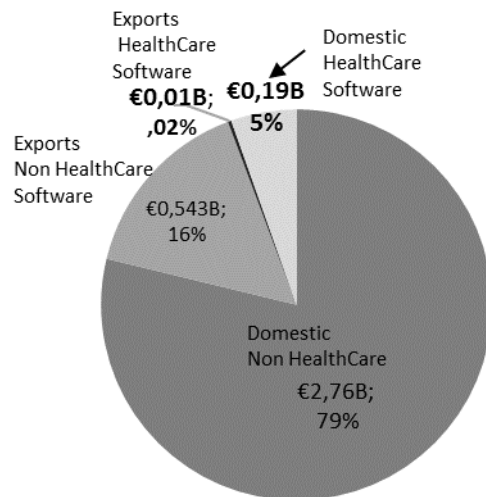


Figure 6: Domestic and Exportations dimensions: Normal/ Healthcare software in Portugal

Following the answers, the markets to where they export are South Europe and Portuguese speaking African countries, following the all sector trend.

Patented sales weight among software for healthcare

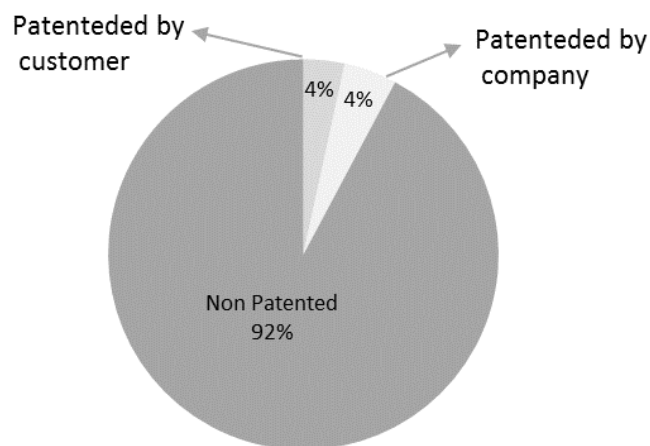


Figure 7: The Patented sales weight among healthcare products in Portugal

About 67% of business is designed for customers and 33% of the business is licensed based. This ratio is different from the national 50/50 orientation. But the situation of non-patent production among the producers of software for healthcare shows low sustainability for the future in this segment(Figure 7). This data is highly influenced by Large Companies that produce services for healthcare products that are not patenting their products at all. If we see company by company the patent strategy is mostly common according to the general market of software.

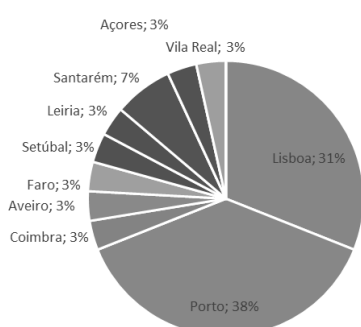
In terms of distribution there is a clear preference for direct distribution and exclusive distributors instead of using diverse distributors, in this case also different from the national preference of diverse instead of exclusive.

The percentage of graduated people is 49%, aligned with national prevalence, but only 6% have a PhD less than the half of national rate of 14%.

The female rate is higher than the national average, 43% vs 34%, and the experience abroad of managers is aligned with the market. The countries where they have been living have some differences comparing to Portugal showing high differences in communication infrastructure and purchasing power of the inhabitants.

The companies that produce software products for healthcare agree mostly that evidence of innovation, EHR and wellbeing technologies are the drivers for this market, but also considers other aspects above the average. As strategic points for this market, they point out the strong human capital, the quality of life in Portugal, the clustering activities, the domestic capital availability, the technological infrastructures, the diaspora and the client's followership.

Regional Distribution Nr Companies with Healthcare Solutions



Exporter Companies by District

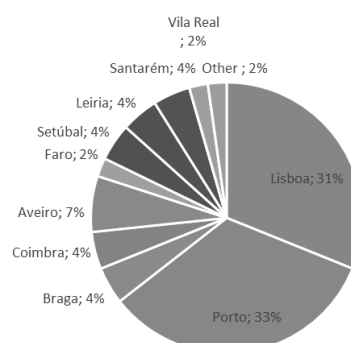


Figure 8: Regional distribution of companies by size

In terms of product segmentation, the companies are targeting caregivers, objectively focused on diagnosis and health control, and oriented for healthcare supervision. For all these reasons, they go mostly for indoor/outdoor instead of home, and criticality is trended for mobile workforces instead of rescue.

The regional distribution of the companies with healthcare solutions and their ability to export is like the national standards, mostly concentrated in the big centers of Lisbon and Oporto (Figure 8).

6. Discussion

For the objective of this thesis it was important to understand how the actors see and think about the healthcare opportunities, more than know what the big entities are performing on this specific market. Both perspectives were important, but in the end of the day, every market agent should count to identify how is the country prepared to face the future.

The ambition of the questionnaire and the common sense about the Portuguese enterprises culture unlikely to give numbers about their activity, drove to a multiple-choice type questions and no open questions.

The multiple choice drove to use the correspondent mid-points to quantify all the dimensions under study. For those above all the limits it was considered the same limit for quantification to not jeopardize the conclusions.

Only a few inconsistent answers were rejected. The software companies are used to prepare and to use these kinds of surveys, and they know how surveys are fundamental to support strategic decisions, to understand the market, to analyze a population or to find a trend of opinions or behaviors.

The identification of Economic Activity Codes was not conclusive, and companies would not be able to answer for each activity what was the portion dedicated to healthcare. A big part of the answers revealed lack of knowledge about the matter. The activity is

dispersed, and only about ten percent of the companies have more than one different activity. So, even knowing the sales for each of the software segments operated by this market, Programming, Consulting, Management of Equipment and Other, which is given by the national statistics institute, “Instituto Nacional de Estatística” (INE), it was important to know what the healthcare weight for all activities is all together and identify the global focus on healthcare. So, more investigation is required to analyze the healthcare weight for each of the mentioned dimensions.

6.1 Software Industry

The concentration of companies in Lisbon and Oporto may be linked to the fact that the software companies are not dependent on any other important industry in Portugal, as automobile, cork, shoes, molds and others normally located out of the centers. So, software industry is not clustered to other industry and companies are operating essentially as services companies or working to big organizations, finding in the big cities the better opportunities to make their business. Also, it is in the big cities where are located the big contractors that can push their development, such as banks, big hospitals, the headquarters of big companies, or the central government departments. We know some recent moves to attract software companies more for the interior of Portugal, like Vila Real and Castelo Branco, but we need more time to understand if these moves will have followers and conclude about a possible urban exodus.

But we have exceptions when the local dynamic acts to attract software companies as Cantanhede, or the technological parks near Lisbon. This attraction must be linked to conditions as sharing space, assets and services. There most known clustering activities that moves companies to concentrate their location are enterprises incubators. Of course, we referred the case of videogames, but more investigation will be required to quantify this clustering.

The location in big cities can be somehow linked to exportations, as we observed low rates, despite more than 40% percent of the companies declared to be exporters,

companies in average exports less than 20% percent. This is the biggest difference we find when comparing this industry with other succeeded industries in Portugal exporting more than 80% of their production. The biggest software companies are also located in the big centers and mostly in Oporto. The reason is probably because the biggest Portuguese multinationals are originated from up in the North of Portugal.

The human resources present higher percentage of graduated and PhD employees than the country known levels, as the existence of foreign employees. The experience of managers abroad is not conclusive, but apparently, even considering their experience in differentiated countries didn't contribute to diversify exportations, mostly done to Portuguese speaking countries and Europe, particularly South of Europe. The female employees' rates, despite there is no dynamic analysis, may probably improve as big companies like to leverage societal balance and the universities have now more women graduating in information technologies engineering than before.

The patented products show unexpected high rates. But as this industry is mainly focused in the domestic market, much probably we have low international patents. Anyway, more investigation will be need in the future to better understand the patent situation in this industry. The distribution is mainly direct, confirming the tailor-made service characteristic.

The exportations are mainly done by Large Companies, but most of the companies in the market exports less than ten percent of their production. The conclusion is that this industry is not focused on exportations. Despite the main destinations are African Portuguese speaking countries and Europe, it is positive to have already companies looking for differenced markets as Oceania, North America and Asian countries. This opportunities and knowledge could be leveraged with the increment on clustering activities in the sector.

Contrary to other industries in Portugal, the software industry doesn't see low wages as an advantage to be competitive in the international market. But the competition from Asian countries should be better analyzed. It seems that the fact of having low focus in the international market should make this industry to revisit their exportations strategies and targeting the countries where its advantages could be recognized and valued.

6.2 Healthcare Segment

The software producers for healthcare seem to have a similar distribution in terms of location as the total industry, so we may assume that the opportunities for healthcare must be concentrated in the big cities as well, specifically in the cities centers.

The motivations to target healthcare products are somehow radicalized, or highly valued or not valued at all. The interpretation of this judging by the companies could mean that part of the industry is aware of the opportunities and other part it is not. What is seems to be clear for the market is that evidence of innovation, Electronic Health Records (EHR), and wellbeing technologies are important strategic factors. But it is disappointing that the actual drivers for the future of healthcare as chronic diseases, population ageing and mobile health still receiving low rates from a significative part of the software producers. Anyway, all the factors are positively classified above 60%, which can be enthusiastic for the future.

As all the industry thinks, the low wages are not seen as an important competitive factor for exportations of healthcare products. Further investigation will determine who are the countries that Portugal will compete in this segment, that could change or not this argument. But clustering, domestic capital availability, quality of human resources are strategic success factors for exportation in this area. The human resources quality is aligned with the total software industry except the rate of employees with a PhD, half of the industry rate.

There is a clear targeting on caregivers, so the software producers still not see the patients as a good driver for this market. This reveals a vision limited to the country market and not taking the opportunities abroad, neither the future that is coming fast with the dissemination of personal hardware as smartphones and watches that are changing all the people behaviors around the world. In terms of purpose the same conclusion can be taken, if we consider that health control and diagnose solutions are targeted for caregivers and not for patients. The development of data bases is very well quoted as well, giving a strong argument for that criticism. The same argument can be used when the industry prefers indoor and outdoor instead of home solutions. The focus is again the caregiver and not the patient. Finally, the orientation and criticality of the

solutions also giving more attention for the supervisors and mobile workers of healthcare instead the self-controlled solutions.

In terms of patents, those companies who produce software for healthcare are not patent their products at all, in opposite to the normal defend strategy took by the industry of software in general. More investigation is required to interpret the link of software for healthcare producers and patent strategies.

6.3 Success Factors

Aspects like clustering and cooperation, differentiation, high quality, psychic distance, exportation destinations and other were common to all observed industries. Therefore, we can take some conclusions about all these aspects for the industry of healthcare.

Following the cluster models and the need of understanding the enterprises type of this industry, this research followed a criterion based on sales volume not taking in consideration the number of people of each organization. The software companies need to be flexible and the number of collaborators can change depending on the business model and strategy followed by the companies. So, people dimension can be different but business power and ability to create value can be measured by business volume. The Large Companies have a higher weight in this industry than national average and it is known that some are Portuguese.

In the contacts with software companies, there is no consistent model of clustering on healthcare products. It seems that the biggest industry in Portugal, the automobile, is starting to push some national companies to bring differentiation and innovation, challenging Portuguese companies to bring more safety for drivers and cars. More investigation to measure this move is needed and it will be important to prove that is already acting in a clustered way and companies work in a competitive system. Clustering is very important to target international markets and the results show that software industry is not succeeded on this so important goal. The investigation didn't find any indicator that could justify a different approach for this industry when compared with others relatively to regional clustering. Despite the good roll of start-ups incubators

around the universities in Portugal, there is no evidence of a clustering activities around the software big companies, like those observed in the cork and automobile industries in Portugal. But, it is probably that sooner or later, the big industries like automobile or the international software companies will push small companies to compete and cooperate to find robust solutions for their industries. Some moves are known about big National Groups out of software industry being investing as business angels and buying start-ups to develop new markets or to offer differentiation on their core businesses. But, as they are noticed seems to be more like opportunistic bets and not consistent creation of a strength in the software area.

The notion of software activities being linked through internet not requiring location aggregation for clustering is discussable even knowing the cluster experiences around the world. Nevertheless, an important player attracting start-ups satellites are common in these markets, as seen in Finland with Nokia and even in Portugal with Portugal Telecom, before its bankrupt. More investigation is required to substantialize and quantify these moves.

This study concentrated efforts to analyze the preparation of the software industry for the opportunity of healthcare, in terms of strategic focus area. It was identified its dimension in terms of domestic and exports areas. Much probably, the domestic area may have as an important customer the public sector, more concretely the Ministry of Health, the main player in healthcare in Portugal as funder, provider and regulator of the National Health Service.

Many institutions governed by the Ministry of Health in Portugal, like public hospitals, health centers and investigation centers, are consuming software services and gravitate their shopping in the central purchasing institution for the Ministry of Health, the so called “Serviços Partilhados do Ministério da Saúde” (SPMS). Being a central purchasing without a concrete strategy to approach the global market, this important centralized buying power may not act as a clustering strength. More investigation is required to analyze how this concentration of production of software for healthcare could be turned on clustering. It is important to refer that the buying process of SPMS, as a public institution, is normally based on public tenders and decided by lower price. The intention

to simplify and integrate the data and processes in public hospitals and departments of the Ministry of Health is not consensual. Physicians are very critics about the amount of systems they must fill when they should be more focused on the patients.

Despite SPMS has been designated to normalize the software area on public hospitals and health centers, this institution buys all the materials and services required by all Ministry of Health dependents without a focus only on software, which may turn difficult any clustering ambition that Portugal may have on the sector through this institution. Anyway, it is recognized the good knowledge of this institution about software production and healthcare needs in Portugal, and it is for sure an important player in the market that may be taken in attention for any cluster strategy for the future.

Other important players on top of SPMS, since they cover more than twenty percent of the healthcare providing market, are the healthcare private groups. Rather than the unification of services wanted by the Ministry of Health for National Health Service, the differentiation is the name of the game for private sector, and software can play an important role on this process, used as a negotiation strength with the payors (insurance companies and sub-systems).

All the economy and crossing activities are being influenced by the globalization process, which is not new in the world history and keep being a common vector in the civilization development from the beginning of humanity. As more global is the world, more we need to be prepared to face opportunities that can be taken if companies have skills and ability to be included. Practically all the important economic activities cannot be hermetically closed in a country market, especially when it is small such as the Portuguese is. The scale is an essential requirement to be competitive when operating internationally and that means to look for exportations as a fundamental focus for the companies, the organizations and the economy sustainability.

Humanity survival and its last decades rapid growth has been possible due to different factors, including the improvement of healthcare through the science and technological development from which we have learned how to beat many epidemic situations and how to avoid its repetition. Mortal diseases have become to be chronic and manageable, and longevity is growing all around the world. It is urgent to find solutions that help

caregivers to control and monitor their patients at distance otherwise the health providers places will be not enough to receive all the patients. In other hand, we must find ways to make patients more empowered to diagnose earlier their diseases and know enough how to follow their medication and procedures without caregiver's direct action. So, it is important to have tools to educate patients properly not only for treatments but also for prevention. In other hand the healthcare stakeholders must give fast information to physicians to update them about new technologies and approaches. Also, we need to find faster and cheaper ways to diagnose diseases and facilitate the active ageing and to able healthier final life phases and permit health systems to be sustainable. Finally, we must find safer and securer ways to have patient data organized and controlled in big data systems to turn the healthcare providing more effective and faster.

The 21st century is deeply marked by the so called fourth industrial revolution where software industry have a main share of responsibility. All the above factors are important opportunities that should be investigated how the Portuguese Software Industry are prepared to face.

On top of clustering and competition, we must analyze the ability for differentiation, high quality, psychic distance, exportation destinations and other, which are common to all observed industries and could be analyzed among the software sector to get a conclusion about the aim of this study.

Exports in the software for healthcare follow the traditional destinations of the normal software market, choosing countries culturally closed to Portugal, so there is low preparation for the real globalization that this market requires. Extend the psychic distance to diversify the exportations destinations is not done only by sending Portuguese experts abroad to improve networking. Much probably the companies may need to really internationalize themselves, by hiring abroad.

Generally, we may conclude that the centralism of the healthcare provision in Portugal is a strength that is not facilitating the so needed clustering and competition in Portugal for the segment of software for healthcare. The exportations are low and concentrated, the psychic distance seems to be short even requiring more precise investigation on the matter. The human resources seem to be adjusted for the coming challenges, but

managers are not aware or at least are not acting as they had the total knowledge about all the healthcare opportunities for the future.

7. Final Conclusion

The objective of this study was finding evidence to determine if software producers in Portugal were prepared or not to face the opportunities that healthcare sector offers for the future. Those aspects were the distribution of producers in terms of company characteristics, such as volume of sales, people, education levels, external experience, exportations, distribution channels and focus on healthcare.

From a literature review, a healthcare software segmentation was proposed to evaluate the targets of healthcare products (e.g. targets, users, local to be used or objectives). All these aspects brought more quantitative elements by crossing statistically significant data, found over a survey to be answered by a representative number of software producers located in Portugal.

But the evolution and innovation of technologies such as software and healthcare technologies are so fast and intensive, this type of reviews must be done with a high frequency, to be updated.

The identification of the success factors through the analysis of different industries in Portugal and other experiences abroad in the software area, helped to find the essential elements that should be included in the research.

Then a questionnaire was developed and tested through a focus group. The questionnaire was sent to the universe of companies associated in the Associação Portuguesa de

Software (ASSOFT) and answers were given mainly by phone. The sample was robust and representative of the sector.

The most positive aspect was the good reaction to the questionnaire with companies showing knowledge about their activity and with opinions about the success factors and to strategic areas to develop healthcare products. They recognize the need to cluster to respond to the international market.

In terms of human resources, the average of graduated and PhD elements in the software industry is high when comparing to the known levels in Portugal. Despite the experience abroad didn't indicate a diversity of experiences to extend the market to a global horizon, the opportunities to create networking in this market are many and managers may have abilities to extend rapidly such networking contacts.

Nevertheless, the exportations destinations are diverse, and we find exportations already at a global level. With the national and international stakeholder's participation, all the dynamic in the market is allowing an interesting growth of start-ups, Large international companies' implantation and expansion of National firms for the international market

The experience of managers abroad is higher among Large Companies, but we need further research to understand if those experiences are inside multinationals with low creation of networking to improve international business attraction. Anyway, the psychic distance in the market seems to be low since the exportations are mainly done to African Portuguese speaking countries and South Europe.

Companies are mainly located in the two big cities, Lisbon and Oporto. But no clustering activities are known on these cities for the healthcare area or any other, rather than start-ups incubators and some opportunistic business angel's activities from big companies.

Even with thirty percent of companies somehow dedicated to the healthcare, only six percent of national production is linked to this area but mainly driven by Large Companies and with low exportations expression, meaning five percent among software for healthcare producers, with no expression in the total market (less than one percent).

The healthcare market is mainly driven for services and the major part of licenses is detained by costumers. The patented healthcare products have no sales expression.

The central purchasing institution of Ministry of Health (SPMS), when try to produce their needs without any market vocation should probably be more focused in the development of this sector helping companies to internationalize their solution for public internal market. So, companies feel no motivation to bet on healthcare sector. As showed in other succeed industries in Portugal, clustering is an essential practice to face international challenges and gain scale in the global market.

Products for healthcare made in Portugal are mainly oriented for caregivers despite companies recognize that chronic diseases and patients monitoring are strategic areas to develop software solutions.

Generally, the human capital seems to be adjusted to face the market in terms of educational levels. But, the market is facing healthcare only as a national opportunity with low attention and interest on the international market.

So, in conclusion, even with some positive aspects above described, the negative findings of our results suggest that software companies in Portugal are not prepared for the future that healthcare sector offers to this market.

Further research is required to understand how healthcare is dimensioned by the software industry in Portugal and if the potential clustering processes can be developed around Large Companies or big stakeholders as hospitals or private healthcare groups that could leverage the small intervenient companies that together could develop the production and innovation of software for healthcare. To scale production to the international market, public and private operators could work together through an organization such as Health Cluster Portugal that get already experience in helping the leveraging of healthcare industries such as pharmaceuticals and medical devices to export more than traditional industries as wine and cork.

The international exposure of this industry to the international market is full of opportunities such as the Web Summit, now planned for the next ten years to be held in Lisbon. As healthcare will be more and more transversal to societies and government policies, it will be more important to frame the value that technology such as software can help for the efficacy and efficiency of healthcare delivery and to help populations to be healthier, live with higher quality and, consequently be more productive.

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Attachments

The questionnaire



SURVEY: HOW ARE PORTUGUESE SOFTWARE COMPANIES PREPARED FOR HEALTHCARE MARKET AND ITS FUTURE CHALLENGES

WELCOME

By participating in this survey you are contributing for Portugal development since there's no Country development without treated information. On top of that, we expect you will help your company to find ways of growing in the future. Please take in consideration the following sponsor entities always focused on the economic growth and to improve people's health and quality of life.

The investigation team of Universidade de Aveiro is sincerely grateful to the responders and to the sponsors of this survey.

INTRODUCTION

The software production in Portugal seems to be very active in diverse markets.

However is very difficult to understand and measure the production by segment and strategically we don't know how is the industry preparing the future, taking realistic opportunities assumed trough demographic and social tendencies that could end in the specialization and country positioning in the global market.

This survey aims to evaluate how the market is prepared for the challenging healthcare market, even from those who don't have actually any production for healthcare.

Answering to this questionnaire will take some of your time but you will be compensated by important information to your company: how specialized is the market for healthcare in Portugal, what are the main segments already covered by national production and how is your company benchmarked in the Portuguese market.

Contact of principle investigator: Luís Pereira (luís.pereira@medtronic.com |917206899)

SURVEY: HOW ARE PORTUGUESE SOFTWARE COMPANIES PREPARED FOR HEALTHCARE MARKET AND ITS FUTURE CHALLENGES

0% 100%

QUESTIONNAIRE

Your answers will be not linked to your name or your company. The investigators will know only if you and your company are responders in order to understand how representative is the sample, but there is no link between your company and respective answers.

This questionnaire will take about 20m to answer.

All questions marked with an asterisk are mandatory.

(certification by Universidade de Aveiro)

1. Please characterize some important aspects about your company and activities.

*** a. What is your total sales range?**
(Answers in Million €)

*** b. How is your business originated from?**

The sum must equal 100.

Only numbers may be entered in these fields

% Custom made	<input type="text"/>
% Licenced base IT solution	<input type="text"/>
Remaining:	100
Total:	0

*** c. What are the Economic Activities Codes (CAE) more often related to your company production in Portugal?**

- 62090 Outras atividades relacionadas com as tecnologias da informação e informática
- 62020 Atividades de consultoria em informática
- 62010 Atividades de programação informática
- 47410 Comércio a retalho de computadores, unidades periféricas e programas informáticos, em estabelecimentos especializados
- Outro
- Não sabe/Não responde

d. How is the patent situation of your products (as percentage)?

The sum must equal 100.

Only numbers may be entered in these fields

Patent by your company

Patent by your customer

Not patented

Remaining: **100**

Total: **0**

*** e. How do you distribute yours products in the market, as percentage?**

The sum must equal 100.

Only numbers may be entered in these fields

Direct

Diverse distributors

Exclusive distributors

Remaining: **100**

Total: **0**

* f. What is the percentage of exports (i.e. total exports versus total revenue)?

Please choose...

* g. What is the weight of healthcare sector in your total business (please consider products and/or services)?

Please choose...

* h. What is the percentage of exportations of Healthcare products (vs total Healthcare products)?

Please choose...

i. What is the percentage of exportations per destination?

North European Countries	Please choose... <input type="button" value="v"/>
South European Countries (Spain, France, Greece and Italy)	Please choose... <input type="button" value="v"/>
East European Countries (Russia includes)	Please choose... <input type="button" value="v"/>
Middle East and Africa (non PALOP)	Please choose... <input type="button" value="v"/>
Africa PALOP	Please choose... <input type="button" value="v"/>
Brasil	Please choose... <input type="button" value="v"/>
South and Center America (Spanish speaking)	Please choose... <input type="button" value="v"/>
North America (US and Canada)	Please choose... <input type="button" value="v"/>
India, Pakistan	Please choose... <input type="button" value="v"/>
Japan and South Korea	Please choose... <input type="button" value="v"/>
Oceania (Australia and New Zeland)	Please choose... <input type="button" value="v"/>
China, Singapore and Vietnam	Please choose... <input type="button" value="v"/>

j. Human Resources (Employees)

*
Number of Head Counts

*
Percentage of graduate people
Percentage of employees following or finished a PhD program
Percentage of foreign employees

*** Gender distribution (as percentage)**

The sum must equal 100.

Only numbers may be entered in these fields

Female

Male

Remaining: **100**

Total: **0**

k. Managers Experience

Number of management people with at least 1 year of international management experience

Next ▶

Exit and clear survey

Resume later

*** Please qualify the differences between Portugal and the main common country where managers lived on (in case there's no common country please consider the country where your manager experience came to be most contributive to your business):**

	Opposite	Many differences	Some differences	Few differences	Close, very similar
Economic level and industrial development	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Communication infrastructure	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Marketing infrastructure	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Technical requirements to develop the business	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Market competitiveness	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Legal regulations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Per capita income	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Purchasing power of customers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lifestyles, consumer preferences	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Level of literacy and education	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Language and culture values	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Beliefs, attitudes and traditions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Next ▶

Exit and clear survey

Resume later

2. Classify as a key factor for the development of a strategy to target the healthcare market?

*** Answers from:**
1-Low Important to 6-Hight Important

	1	2	3	4	5	6
a. Chronic disease impact	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
b. Ageing population	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
c. Mobile phones market	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
d. Use of smartphones by healthcare professionals	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
e. Mobile health (mHealth) market	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
f. Healthcare expenses	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
g. Digital literacy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
h. Evidence of innovation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
i. Electronic health records	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
j. Personal health records	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
k. Well-being technologies	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
l. Health literacy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Next ▶

Exit and clear survey

Resume later

3. Please evaluate the following success factors for exports

*** Answers from:**
1-Low Important to 6-Hight Important

	1	2	3	4	5	6
a. Influence of Government vision and strategic funding activities, launch of specific infrastructures	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
b. Strong Human Capital developed by Universities in Portugal resulted from past long term investments	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
c. Take advantage of the Quality of Life in Portugal to attract foreign talent or as a retention factor	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
d. Low wages in Portugal permit competitive prices in the global market	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
e. Clusters to find national and international customers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
f. Domestic capital availability	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
g. Technological infrastructure present in startups incubators and industrial parks	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
h. Linkages through cultural and linguistic factors, diaspora, etc.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
i. Client followership, from one to another	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

NOTE: If your company is not developing any software for healthcare please disregard next group of questions.

4. Product Segmentation

We are proposing a segmentation for healthcare software market. We would like to have an idea how we can segment your main products for healthcare (up to five).

Consider the main 5 of your healthcare products (A-E)
Click one or multiple choices per product

a. Target: according to the user or the final beneficiary

	A	B	C	D	E
Caregivers (for example, health professionals or relatives who assist the patient)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Patients	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Chronic patients	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Elderly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

b. Objectives: product's purpose

	A	B	C	D	E
Individual (for example, apps to control health data or signs, useful to monitor health conditions or common use in fitness and health control needs)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Health control and diagnose (for example, systems to control healthcare like text messaging for clinical and therapeutic monitoring, or even smartphone devices to measure heart beats/ waves, glucose and other)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Education for healthcare professionals	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Database (for example, individuals, clinicians and health funders/regulators applications to preserve health data, allowing cross consultation and faster emergency healthcare delivery)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Community care (for example, direct links to patients homes without intermediary health workers)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

c. Local: where the product will be used

	A	B	C	D	E
Indoor and outdoor	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Home	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

d. Interaction: concepts like usability or accessibility

	A	B	C	D	E
Products adaptable to the health condition and capabilities of the user	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

e. Orientation: how it is used

	A	B	C	D	E
Self-healthcare (only users are involved)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Assisted healthcare (the patient calls the caregiver)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Supervised healthcare (for example, monitoring systems, involving a remote database)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

f. Criticality: used in emergent situations

	A	B	C	D	E
Rescue and emergency management	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Mobile workforce, safety and health management	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Submit

Exit and clear survey

Resume later