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THE USE OF ICT IN TODAY'S SOCIETY FROM THE PERSPECTIVE OF CITIZENS AND BUSINESSES: SECURITY RISKS AND THEIR INFLUENCE ON THE QUALITY OF LIFE OF THE PORTUGUESE POPULATION

Abstract: *Information and Communication Technologies (ICT) have assumed a key role in today's society. In fact, we are witnessing an increasingly widespread use of the Internet, a trend seen both at the level of individual citizens and companies, which more and more use these new technologies to promote their products and services. The state entities themselves are also dependent on ICT, due to a digitalisation of public services.*

In order to determine the impact that the dissemination of ICT can have on society, it is necessary to understand how people and businesses use the internet, namely the information they share or the use of e-commerce. This study frames Portugal's situation in the global context, making it pivotal in order to prevent/minimize risks, showing the habits of people and companies and, more importantly, the trends that can be seen. It can help chart the path to follow in order to prevent cyberattacks and, with this, ensure people's quality of life, which can be greatly affected by cyber risks.

Keywords: *ICT, Internet, Cybersecurity, Information Security, E-Commerce, Quality of life.*

1. Introduction

Cybersecurity is an important knowledge area in today's society. In fact, with the increasingly widespread use of Information and Communication Technologies - ICT, the risk of cyber attacks increases exponentially. This phenomenon affects not only individual citizens but also companies and even state entities. In order to determine the impact that cyber attacks have, it is necessary to understand how people and companies use ICT. Indeed, the Digital Density Index - DDI of a country says a lot about its activities, being directly related to its economic growth. Thus, the rate of Internet use, the frequency of its use and the respective age groups, the use of cloud services, the percentage of broadband connections, the use of mobile devices, as well as the amount of traffic used, are good indicators of the country's technological evolution. In addition, one of the great advantages brought by the generalisation of ICT is the ability to buy and sell products online. The introduction of e-commerce was fundamental for the growth of certain companies, which are now able to advertise their products more widely, reaching a larger number of potential buyers, without geographical limitations. The rate of use of e-commerce is also key to assessing the behaviour of each country.

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Despite the many advantages of this "digitalisation" of society, it carries several risks, ranging from identity theft, scam emails or phone calls, online fraud, offensive material and child pornography, material promoting racial hatred or religious extremism, access to online services, email account hacking, online banking fraud, cyber extortion or malicious software (Carvalho et al., 2020a; Ferreira et al., 2019; Commission, 2017). All these risks can have a significant impact on people, not only financially but also on their quality of life, leading for example to situations of anxiety or cyber bullying (Sá et al., 2019).

In order to determine the impact that the widespread use of ICT may have on society, it is necessary to understand how people and companies use the internet, namely the information they share or the use of e--commerce. In fact, questions such as "what devices do people use to access the internet?" and "what activities do they perform online?" serve to profile users, serving as a basis for studying the potential risks inherent to such use (Thach et al., 2021).

Therefore, if the widespread use of ICT has brought a panoply of new services that have greatly facilitated the lives of citizens and companies, it also increased and diversified the risks involved, so the study of the use of these technologies by society becomes central to try to prevent/minimise the risks. The study presented in this article places Portugal in the global context, showing the habits of people and companies and, more importantly, the trends in this area. It can help to trace the path to follow in order to prevent cyber-attacks.

2. ICT Use in Portugal

The use of Information and Communication Technologies has increased significantly in recent years.

Some advantages of ICT use in society are that it can help to improve communication and collaboration, to increase productivity and efficiency, and to make tasks easier and faster to complete. Additionally, ICT can help connect people with others around the world, and it can provide access to a wealth of information and resources. ICT is widely used in the business sector, and the Portuguese government has been investing heavily in ICT infrastructure and initiatives to promote their use in the country. The Portuguese government has been investing in ICT in order to improve the country's competitiveness and attractiveness to foreign investors.

In fact, according to Martincevic (Martincevic, 2022), being competitive, achieving and ensuring long-term competitiveness is impossible today without new digital technologies that create a precondition for achieving it. Consequently, ICT investment has been a key priority for the government in recent years, and it has been working to create a more favorable environment for businesses to invest in and use ICT. The government has also been working to improve access to ICT infrastructure and services, and to promote the use of ICT in the public sector.

Indeed, within the potential advantages of using ICT are entertainment, access to healthcare (Carvalho et al., 2015), long-term care (Queirós et al., 2010), social care (Carvalho et al., 2012), use of public services, banking operations, education (Lazic, 2016), tourism (Carvalho et al., 2020b, Figueiredo et al., 2021), among others.

However, the use of ICT brings security risks, which may compromise the confidentiality of citizens and companies' information. Actually, as the critical financial sector is adapting to incorporate more and more remote operations, there is the potential for increased vulnerabilities and potential amplification of the effects of cybersecurity threats (Thach et al., 2021).

In order to determine the impact that cyber attacks may have on our society, it is

necessary to understand how people and businesses use ICT. In fact, the Digital Density Index of a country says a lot about its activities, being directly related to its economic growth. As such, the rate of Internet use, the frequency of its use and the respective age groups, the use of cloud services, the percentage of broadband connections, the use of mobile devices, as well as the amount of traffic used, are a good indicator of the country's technological evolution. The use of e-commerce is also a good indicator of the technological development of a country.

The following subsections address the use of ICT in Portugal, both by citizens and businesses.

2.1. ICT Use in Portugal by Citizens

The use of ICT has increased exponentially in recent years, becoming part of citizens' lives. In fact, internet has become an integral part of people's daily lives, and there has been an increase in its use of 24.4% (on average) in OECD countries between 2006 and 2016, showing a value of 83.8% in 2016. This trend was also seen in Portugal, with an increase of 34.8%. Nevertheless, although it is a higher percentage of growth than the average in OECD countries, remains, in absolute terms, below them, with only 70.4%.

Regarding daily internet users, in 2016, Portugal, with a value of 59.5%, was also below the OECD average (73.7%), with only 51% of people using mobile internet through, for example, mobile phones/smartphones (62% in OECD) (OECD, 2017a).

Regarding the frequency of internet use by people aged 16-74, the Portuguese numbers (70%) are well below the EU28 average of 82% (2016 data) (Eurostat, 2016). Of these people, around 86% used the internet daily, which represented 60% of people aged 16-74 (71% in the case of the EU28) (Barros, 2018).

Despite the scenarios presented, there is a large discrepancy between the various age groups under study. There is a difference of 60.6% when comparing the results obtained with users aged between 16 and 24 years (99.1%) and the percentage of users aged between 55 and 74 years. In fact, the percentage of the youngest is very high, being even above the OECD's 96.5%, which indicates a tendency for the situation in Portugal to improve in the coming years (OECD, 2017b).

This growth trend is verified in a 2019 study conducted by the European Commission (Commission, 2020), which finds that 76% of people surveyed use the internet daily (an increase of 11% compared to 2015), while 9% use it frequently. Only 13% report never using the internet, decreasing this percentage by 2% compared to 2015, and 2% do not even have access to it (compared to 5% in 2015). Portugal follows this trend (67% use internet daily, 5% often, 21% never, 7% have no internet). Portugal is still showing, however, quite lower numbers than the European average regarding internet use (67% use internet daily (76% in EU), 5% often (9% EU)). It shows also much higher numbers of non-users (21% never (13% EU), 7% have no internet (2% EU)), showing here that there is still a way to go. If we add the 67% of daily Internet users with the 5% of frequent users, we have 72% of the population using the Internet occasionally, the lowest number in the EU (the Netherlands is the country with the highest percentage, reaching 99%). The 21% of the Portuguese population who say they don't use the Internet is one of the highest in the EU, only surpassed by the 25% in Romania, 24% in Poland, and 22% in Bulgaria and Lithuania. The 7% of the population that claims not to have Internet is also a worrying situation within the EU context, only surpassed by the 8% in Greece and Malta.

One aspect to bear in mind is the relationship between the level of education/learning of citizens and internet use. The 2016 data show that the percentage of internet users

with higher education is 98.4%, a high figure and in line with that found in most OECD countries (only in the United States the result is bellow 90%). Despite the high value, in Portugal there is a large discrepancy when compared with citizens with lower levels of education (51.5%) (OECD, 2017c). These results show that people with low education are a potential focus for strategies to promote digital inclusion. On the other hand, the increasing educational level recorded in Portugal allows anticipating a decrease of this gap in the future (Barros, 2018).

Through the 2019 study (Commission, 2020) it is found that men use more internet daily than women (79% against 74%). There is also a direct relationship with age, with a substantial decrease in the over-55 age group. The numbers obtained for daily Internet users among retired or homebound people is also substantially low (42% and 69% respectively), when compared with the 99% of students who use the Internet on a daily basis. At this level, it is necessary to develop policies to integrate older people with technology, namely, with specialised software for their well-being.

The citizens' level of education is also a factor to have into consideration, since 90% of those who completed their education at the age of 20 or older use the Internet daily, as opposed to 36% of those who left school till the age of 15.

There is also a direct relationship between people's economic level and daily internet use (78% for people with economic stability versus 61% of people with more financial difficulties). Here, the solution to increase these numbers may be to create digitalisation programmes for society that provide, for example, a minimum Internet package to the most needy citizens. This discrepancy can also be seen when comparing urban centres with rural areas (81% and 72%), and this difference can be compensated by the above--mentioned incentive programmes.

In turn, broadband connections make it possible to identify the level of household access to services and information. As seen in most OECD countries, the number of subscriptions increased in Portugal by 7.64% between December 2015 and December 2016, substantially above the OECD average (3.28%) (OECD, 2017d). At this level, Portugal records an average of 1.52 GB of traffic per month per broadband subscription, well below the OECD average (2.30 GB).

As for mobile access, the mobile broadband penetration rate increased 158% between 2010 (24.3%) and 2016 (62.7%), above the OECD average (126%). Despite this, the 62.7% is still well below the OECD's 99.25%, being mostly data and voice subscriptions (57.3%) (OECD, 2017e). There is a wide disparity in access between rural and urban areas (14.6%), with Portugal being one of the countries with the largest gap, a value that has increased since 2010 due mainly to greater growth in urban areas (OECD, 2017f).

Another relevant aspect to assess the technological situation of a country is related to the use of cloud services by its population. In Portugal, 33.5% of internet users used these services in 2016, a growing scenario (31.8% between 2014 and 2016). Among the users, those in the age group between 16 and 24 years old stood out (54.6%), which represents a favourable outlook for the coming years (OECD, 2017g).

In Portugal, the percentage of people aged 16--74 who used the internet to interact with public authorities in 2016 was 44.7%, below the average of OECD countries (53.8%). According to OECD (OECD, 2017h), to the difference recorded between the various countries contributes, among other factors, the difference in the percentage of internet users and the availability of e-government services. Despite this, a large discrepancy is observed between the various age groups, and if we only consider individuals between 25 and 54 years old, the result is 57.7%, which shows a very significant future evolution trend. In fact, Portugal recorded a

sharp increase between 2010 and 2016 (18.6%), the 5.th largest increase within the OECD countries for which information is available (OECD, 2017h).

2.2. ICT use in Portugal by Companies

As well as analysing the use of ICT by citizens, the study of their use by businesses is key to determining the development of a given country. In this regard, in Portugal there is a widespread use of ICT by companies. In fact, in 2016, 96.3% of companies had a broadband connection (an increase of 11.6% compared to 2010). More specifically, companies with more than 250 employees had a rate of 100.0%, while companies with between 50 and 249 employees had a value of 99.9%. Only at the level of companies with less than 50 employees this result was slightly lower (95.6%) (OECD, 2017i), a representative value considering the country's business fabric. Furthermore, it is important to note that the gap between small and medium-sized enterprises with broadband decreased from 9.1% in 2010 to 4.3% in 2016 (OECD, 2017j), a significant reduction, highlighting the investment that has been made by companies in technology.

As well as the use of broadband, the provision of a website is also a relevant factor. In 2016, around 64.2% of Portuguese companies had a website or page, below the OECD's 77.0%. This represents an increase of 12.3% compared to 2010 (in which the percentage was 51.9%), slightly below the OECD's 12.8%. As might be expected, large enterprises have a higher value (95.2%), compared to 80.1% for medium enterprises and 60.8% for small enterprises (OECD, 2017k). In addition to the website, 43% of companies used social media in 2016 (Eurostat, 2016).

If we consider companies with more than 10 employees, we find that only 17.9% of Portuguese companies use Cloud Computing, 20.5% make use of Customer Relationship Management (CRM), 8.5% perform large- -scale data analysis (Big Data), 14.5% use radio frequency identification (RFID), and 43.8% adopt Enterprise Resource Planning, a high value in relation to the other European countries (OECD, 2017l).

In Portugal, in 2015, 34.1% of companies sent an online invoice to public authorities (slightly below the EU28 average (35.6%)). The use of the internet for this purpose is higher in large enterprises (57.2%) than in small enterprises (32.6%) (OECD, 2017m).

Regarding the use of Cloud Computing, the number of Portuguese companies making use of this technology increased by 5% between 2014 and 2016, having a value of 18%. This value is still below the 21% average of the European Union countries. At this level, there is a large discrepancy between the 43.8% of large companies, 28.1% of medium-sized companies, and 15.6% of small companies (Eurostat, 2016). 27.5% of companies that did not use cloud computing at its full potential reported that one of the major problems was related to perceived difficulties in cancelling the service or changing providers, and being held hostage to possible service price increases over time. This concern is common to all types of companies, regardless of their size (27.8% in small, 26.9% in medium-sized and 26.2% in large companies) (OECD, 2017n).

As for the use of management tools in companies, this index increased by 17.8% between 2010 (26.0%) and 2015 (43.8%). Here there is a huge discrepancy between the business fabrics, ranging from 91.8% for large companies to only 37.4% by small companies (OECD, 2017o).

In turn, 13.4% of enterprises did large-scale data analysis (Big Data) in 2016 (large enterprises 23.9%, medium-sized 17.1%, and small enterprises 12.5%). The use was primarily for geolocation from mobile devices (56.6%), information generated from social media (54.4%), and data from companies' own smart devices or sensors

(28.0%) (OECD, 2017p). This use is led not only by the ICT sector but also by the services sector (utilities) (particularly data from smart devices), transport (information from mobile devices), and also accommodation and food (data from social networks) (OECD, 2017q).

Finally, analysing the investment made in ICT is a good indicator of the state of a given country with regard to its technological infrastructure. Checking the EU28 countries, Portugal shows the largest decrease in this rate between 2009 and 2016, dropping from 3.24% to 1.79% of GDP, a decrease of 45%. In fact, 32% of Portuguese companies seeking ICT specialists say they have difficulties in hiring them, a figure above the 0.9% of total companies that was seen in 2012 (OECD, 2017r). From this indicator we can conclude that the increase in demand was not accompanied by an increase in supply, although there is still a significant number of specialists in this area in the market.

2.3. Forms of Internet Access

Regarding the forms of Internet access, smartphones are prominent (85%), a much higher value than the 51% of laptops, 41% of computers used exclusively at home, 35% of tablets, 23% of TVs, or 9% of game consoles (Commission, 2020).

Regarding the use of smartphones, this trend has been increasing in recent years, with an increase of 24% from 2014 to 2019. This was also visible in the use of TVs, which increased from 11 to 23%. In the opposite direction are computers, which have dropped sharply from 92% in 2014 to 76% in 2019, considering here both laptops and computers for exclusive use at home. Also tablets, although they have been on an upward trend (they increased from 30% in 2014 to 40% in 2017 and 2018), they are currently on a downward trend, with a value of 35% in 2019.

What we are seeing is a transition of internet usage to smartphones, to the detriment of computers and tablets. TVs are also increasing the number of accesses, which is largely due to the technological advancement of the TVs themselves, with better internet connection, but also of service providers (both movies and music), which increasingly provide quality content in quantity, in a way that is easy to access for the user (Costa et al., 2019; Santos et al., 2021; Barbosa et al., 2021).

This trend can be seen in Portugal, with 91% of Internet users using their smartphone. Portugal is one of the countries with the highest value, only surpassed by the 96% in Spain, 93% in Sweden and 92% in Austria. These 91% of users represent a 5% increase in relation to 2015, which shows a high growth trend.

Regarding internet access through a laptop, Portugal has one of the lowest values, with 30% (51% in the EU), and only Italy has a lower value with 17%. When considering computers for exclusive use at home, Portugal, with 50% of users, is above the 41% of the EU, but still far from the 61% of Italy.

Regarding the use of tablets to access the Internet, the 26% of Portuguese users are lower than the 35% of the European Union average, placing Portugal in the fourth bottom of the ranking, although substantially above the 13% from Poland.

In turn, the analysis of the use of TVs as a means of access to the Internet shows Portugal far behind the other EU countries, with only 7% (last in the ranking), compared to the EU average of 23%. Consoles show similar results, with 3% against 9% of the EU average, although here there is a large group of countries with equally low or even lower values.

2.4. Activities carried out online

Just as important as understanding the ways in which people access the internet, is to understand the activities carried out online.

Email continues to be the most used activity, with 80% of respondents answering that they access the Internet to read email. This is followed by reading news, blogs or forums (62%), the same as using social networks (62%), banking (61%), buying goods or services (55%), sending messages (51%), voice or video calls (41%), entertainment (40%), accessing public services (36%), playing online games (25%), selling goods or services (22%), or e-learning (16%) (Commission, 2020).

If the average of 80% of EU respondents who say they access email is the highest value in terms of activity carried out online, there is a large discrepancy between the various countries, with values ranging from 39% in Romania to 98% in the Netherlands. Portugal has a value of 75%, slightly below the EU average.

With regard to the use of social networks, Portugal is the country with the highest score (87%), well above the EU average of 62%.

A great discrepancy is also found regarding the reading of news, blogs and forums, since if the EU average is 62%, Romania has only 47%, while Sweden has 91% of users. Portugal is slightly below the EU average, with 58%.

As for the use of banking services, there is a very significant variation between countries. Nordic countries (Finland, Denmark and Sweden) have 94% of respondents admitting the use of these services, as opposed to only 13% in Romania. At this level, Portugal, with 40%, is one of the countries that makes less use of these services, well below the 61% of the EU average.

Buying goods or services online represents 55% of the activities carried out by EU citizens. Portugal has one of the lowest values at 36%, along with Cyprus and Hungary, and only surpassed by Bulgaria (33%), Croatia (32%) and Romania (25%). At the other extreme is Sweden with 86%.

The Portuguese position changes substantially when it comes to instant messaging, since with 73% Portugal is well above the 51% EU average, and only surpassed by Sweden (80%) and Spain (78%).

Regarding audio or video calls, Portugal is also above the EU average (51% and 41% respectively). This ranking is led by Sweden, with 68%, and in last place is Poland with only 27%.

With regard to entertainment, Portugal has a very low result, only 26%, compared to 40% in the EU. Sweden is once again at the top of the ranking with 77%. Slovakia comes last with 22%.

As for access to public services, Portugal has a percentage of 42%, above the EU average of 36%, although far from the 84% of Denmark, which leads the table. Romania closes the list with only 9%.

In turn, online gaming represents on average 25% of the activities carried out online by respondents in the EU, and is the parameter in which there is greater balance between the member countries of the Union. Portugal has a value of 29%, not far behind Austria, with 35%. Slovakia and Ireland close the list with 18%.

The sale of goods or services online represents only 22% of the actions carried out by citizens on the Internet. At this level, Portugal is far below with only 12%, on a par with Romania and Spain, surpassing only Bulgaria (11%), Greece (6%) and Cyprus (3%). At the other extreme is once again Sweden, with 39%.

Finally, e-lerning represents 16% of the activities carried out online. Portugal comes last in the ranking with only 5%, while Finland is the EU country that makes most use of this teaching method, with 36% of respondents.

2.5. The use of E-Commerce by Citizens

E-commerce is one of the gains that ICT have made possible for citizens and companies. Its use is an essential parameter to analyse when we want to assess the use of technologies in a given country. It is not only about the money involved in these transactions. Actually, it allows to verify people's trust in technologies.

Considering the year 2016, in Portugal only 31% of people aged between 16 and 74 ordered goods or services over the internet for private use, a figure well below the 55% of the EU28 average. Moreover, the increase between 2012 and 2016 was 9%, being also below the EU28 increase of 11%, which shows a departure in this field (Eurostat, 2016).

If we consider only internet users, 44.0% purchased goods online, far below the 61.1% average of OECD countries. Despite this, there has been a significant evolution in recent years, with a 16% increase since 2010 (OECD, 2017s).

Regarding the origin of products, in 2016 78.4% of people who shopped online bought from domestic sellers, compared to 52% who bought from EU28 sellers and only 27% from non-EU countries (OECD, 2017t).

2.6. The use of E-Commerce by Companies

E-commerce is an asset for modern companies. In fact, the internet enables companies to advertise and sell products to a much wider range of potential buyers, in a global reach. Despite this, in 2016 it was found that only 15.0% of Portuguese companies paid for internet advertising (Eurostat, 2016). This figure is related to the percentage of companies that have a website, with Portugal showing a low value in this respect.

In 2015, 18.8% of Portuguese companies made sales over the internet, which is in line with the 20% of the EU28 (Eurostat, 2016) and close to the 22% of the OECD. However, if in the OECD there was an increase of 3% in relation to 2009, in Portugal there was a drop of 0.6%. These results should be associated with the national business fabric, where small and medium-sized companies prevail, which have less activity in this area (18.2%) compared to 44.2% of large companies (OECD, 2017u). To confirm the low impact of e-commerce on Portuguese companies, its turnover in 2015 represented only 2.6% of retail turnover, ranking last in the EU28, which has a much higher average (8.7%) (OECD, 2017v).

Regarding the Portuguese companies that traded electronically in 2014, a high percentage sold outside the country (43.5% to other European countries and 31.1% to non- -European countries), above the EU28, with 41.7% and 25.3% respectively, with a significant increase in sales outside the Union (12.5%) (OECD, 2017x).

3. Methodology

The Special Eurobarometer series on cybersecurity is an essential resource for learning about cybercrime in Europe (Commission, 2017). This resource's importance stems from the treatment and analysis of representative data of different types of cybercrimes collected in the last seven years in the 28 member states of the European Union.

The most recent report covers a wide range of threats and aims to understand European citizens' experiences and perceptions of cybersecurity issues. This survey, adopted in this report, was carried out between the 8th and the 22nd October 2019, by TNS opinion & social, carried out the wave 87.4 of the Eurobarometer survey, on request of the European Commission. The wave 87.4 covers the population of the European Union Member States' respective nationalities, residents in each of the 28 Member States, and aged 15 years and over. In total, 27607

respondents (1007 from Portugal) from different social and demographic groups were interviewed face-to-face at home in their mother tongue on behalf of the Directorate-General for Home Affairs.

The findings from this survey, update previous surveys that were carried out in 2013 (Commission, 2013), 2015 (Commission, 2015), 2017 (Commission, 2017), and 2018 (Commission, 2018). The 2019 survey (Commission, 2020) repeats most of the questions asked in 2015 to provide insight into the evolution of knowledge, behaviour and attitudes towards cybersecurity in the European Union.

The documents published by the Portuguese Ministry of the Economy are also extremely important, as they provide an overview of the Portuguese position in relation to the other EU members. The document considered, Economic Themes - Cybersecurity in Portugal (Barros, 2018), from 2018, provides a set of relevant information regarding the use of ICT by the Portuguese citizens.

The study presented in this article aims to understand the potential risks in terms of cybercrime, focusing fundamentally on the analysis of the behaviour of Portuguese people regarding online activities. The use of ICT by citizens and companies, as well as the use of e-commerce, are fundamental aspects to take into account, as well as the way people use the Internet, more specifically the forms of access and the content they access.

4. Results

The last years have seen an exponential and increasingly use of ICT. Its advantages are unequivocal, allowing an improvement in the quality of life of citizens and an opportunity for companies. Through its use, citizens can access an immense panoply of information from anywhere. From the use of smartphones for calls or email access, to e-commerce, these technologies came to make people's lives easier. Regarding companies, they get not only better access to information but also new ways to communicate and interact, both with their employees and with potential buyers of their products, through digital marketing and e-commerce.

However, despite the many advantages of this "digitalisation" of society, it carries several risks. To try to minimise these risks, it is necessary to study and understand the behaviour of the Portuguese citizens and companies online.

Figure 1 compares the results obtained in Portugal with the OECD average in a 2016 study (Barros, 2018).

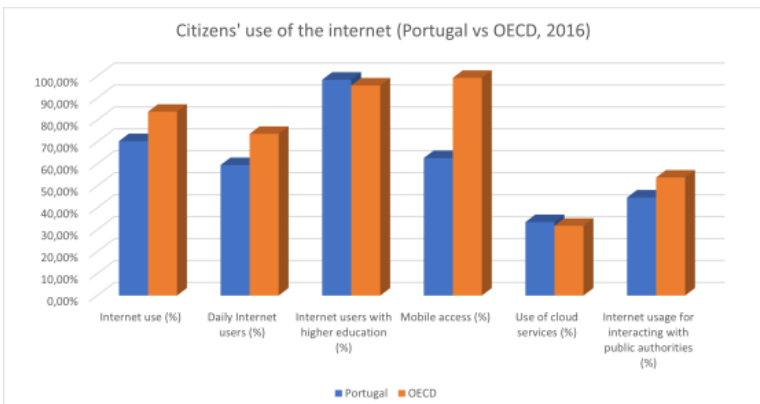

Figure 1. Citizens' use of the Internet (Portugal vs OCDE, 2016)

As it can be observed, in terms of internet use, Portugal, with 70.4% of users, is below the OECD's 83.8% average. However, there is a tendency for this gap to decrease, as the increase in Portugal between 2006 and 2016 was much higher than the OECD average (34.8% against 24.4% respectively).

As far as daily internet users are concerned, Portugal, with 59.5%, is also below the OECD average of 73.7%. The difference between Internet users in Portugal and OECD decreases significantly when only users with higher education are considered.

At this level, Portugal, with 98.4%, is above the OECD average, showing here a large discrepancy in use between the different levels of education.

Regarding mobile access, despite the scarce 62.7% of users, against 99.25% of the OECD, the growth in Portugal was 158% between 2010 and 2016, much higher than the 126% growth of the OECD.

Looking at the use of cloud computing services, Portugal shows a value of 33.5% among internet users, a growing figure (31.8% increase compared to 2014), with special emphasis on the 54.6% in the age group between 16 and 24 years, which shows a marked growth perspective.

Finally, in the use of the Internet to interact with public authorities, Portugal is, with 44.7% of users, below the 53.8% of the OECD average. At this level, there is a large discrepancy between countries, which according to the OECD is due to, among other factors, the difference in the percentage of Internet users and the availability of e--government services.

Figure 2 shows a comparison of the values obtained by Portugal in relation to the EU with regard to the frequency of internet use, values obtained in a 2019 study conducted by the European Commission (Commission, 2020).

Portugal still has much lower values than the EU average for Internet use (67% use the Internet daily (76% EU), 5% frequently (9% EU)) and much higher values for non-users (21% never use (13% EU), 7% have no Internet (2% EU)), showing here that there is still some evolution needed.

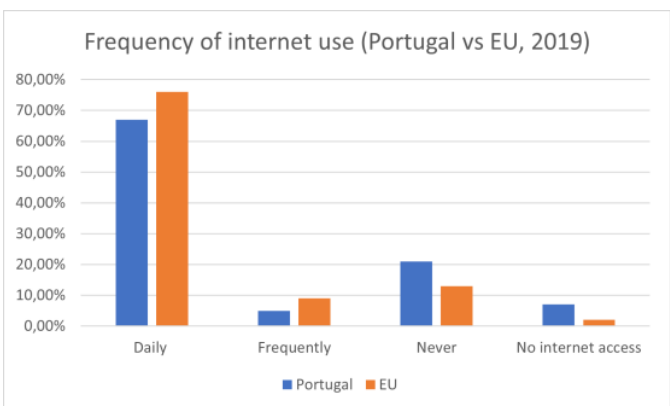

Figure 2. Frequency of internet use (Portugal vs EU, 2019)

If we add the 67% of daily Internet users with the 5% of frequent users, we have 72% of the population using the Internet occasionally, the lowest value in the EU.

The 21% of the Portuguese population that says they do not use the Internet is one of the highest in the EU. The 7% of the population who say they have no Internet is also a worrying situation in the European context.

Figure 3 shows the comparison between the percentages of Internet users regarding several factors such as: men vs. women;

students vs. retired people; people who completed their education after 20 years old vs. people who gave up their studies before 15 years old; and people with economic stability vs. people with difficulties.

From Figure 3 it is possible to observe that men use the internet daily more than women (79% versus 74%). There is also a direct relationship with age, with the numbers obtained for daily internet users in retired people being substantially low (42%) when compared to the 99% of students who use the internet on a daily basis.

The level of education of citizens is a similarly factor to take into consideration, as 90% of those who completed their education at the age of 20 or more use the Internet daily, as opposed to 36% of people who left school by the age of 15.

There is also a direct relationship between people's economic level and daily use of the Internet (78% for people with economic stability versus 61% of people with more financial difficulties).

Figure 4 shows the ways of accessing the Internet. Regarding the forms of Internet access, smartphones are prominent (85%), a percentage much higher than the 51% of laptops, 41% of computers used exclusively at home, 35% of tablets, 23% of TVs, or 9% of game consoles (Commission, 2020).

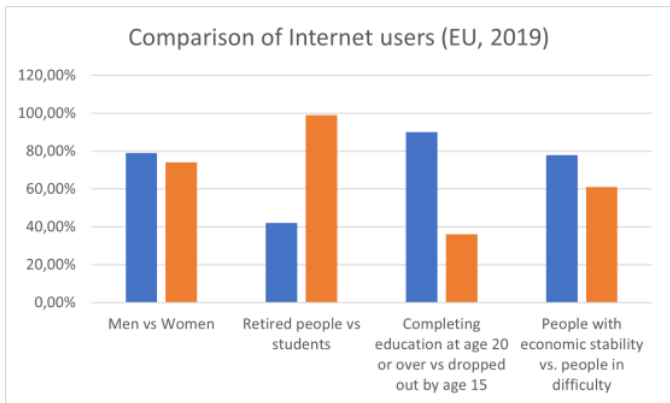

Figure 3. Comparisson of internet users (EU, 2019)

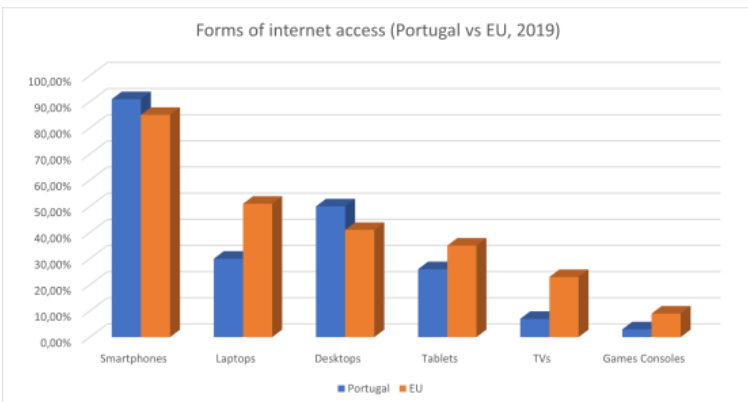

Figure 4. Forms of internet access (Portugal vs EU, 2019)

Regarding the forms of Internet access, smartphones are prominent (85%), a percentage much higher than the 51% of laptops, 41% of computers used exclusively at home, 35% of tablets, 23% of TVs, or 9% of game consoles (Commission, 2020).

What we are seeing is a transition of internet use to smartphones, to the detriment of computers and tablets. TVs are also increasing the number of accesses, which is largely due to the technological advance of the TVs themselves, with better internet connection, but also of the service providers (both movies and music), which increasingly provide quality content in quantity, in a way that is easy to access for the user.

Portugal follows this trend, showing an even greater prominence of the use of smartphones and desktops. On the other hand, it shows a substantially lower value of the use of laptops, tablets, TVs and Game Consoles.

Figure 5 shows the activities carried out online.

Figure 5 shows that email continues to be the most used activity, with 80% of respondents answering that they access the Internet to read email.

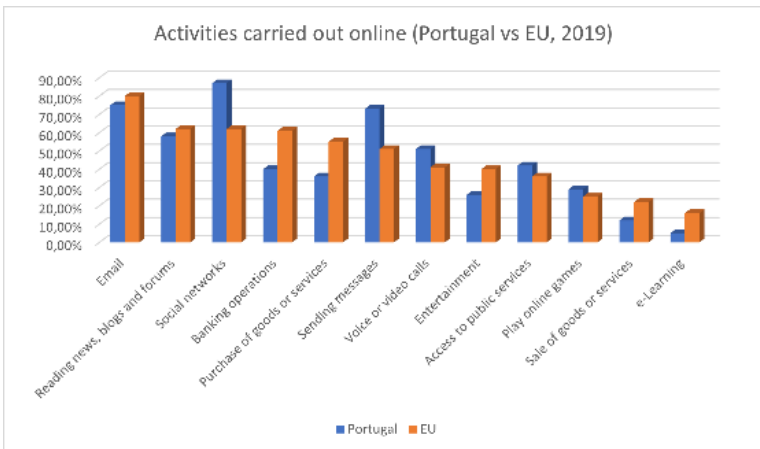

Figure 5. Activities carried out online (Portugal vs EU, 2019)

It is followed by reading news, blogs or forums (62%), the same as the use of social networks (62%), banking (61%) buying goods or services (55%), sending messages (51%), voice or video calls (41%), entertainment (40%), accessing public services (36%), playing online games (25%), selling goods or services (22%), or e-learning (16%) (Commission, 2020).

Portugal is broadly following EU trends. The main differences are found in the use of social networks, where Portugal is the EU country with the highest score (87%), well above the 62% EU average, and messaging, where, at 73%, Portugal is well above the 51% EU average.

In contrast, banking, buying goods and services, hosting, selling goods and services and e-learning, are activities where Portugal is significantly below the EU average.

Figure 6 shows the use of e-commerce by citizens.

As can be seen in Figure 6, Portugal still has a long way to go when it comes to purchasing goods and services over the internet, with results well below both the EU and OECD.

Figure 7 shows the origin of the products purchased by Portuguese citizens through e--commerce. It 7 shows that the Portuguese citizens continue to have more confidence in buying from national sellers when compared

to sellers from within the Union, and even more if we talk about those from outside the EU.

Figure 8 shows the use of ICT by firms in a comparison between Portugal, EU28 and OECD.

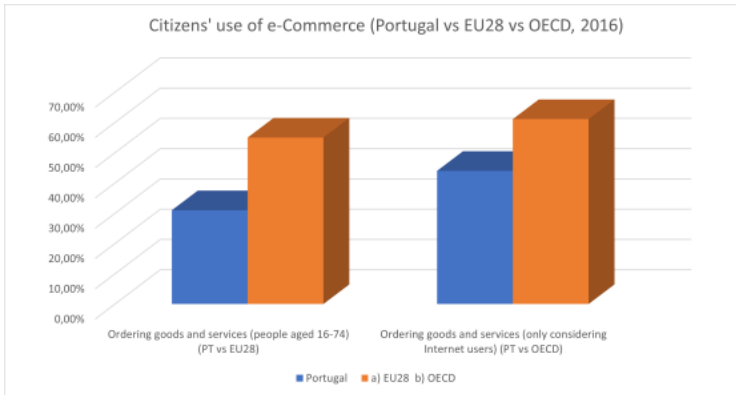

Figure 6. Use of e-commerce by citizens (Portugal vs EU28 vs OECD, 2016)

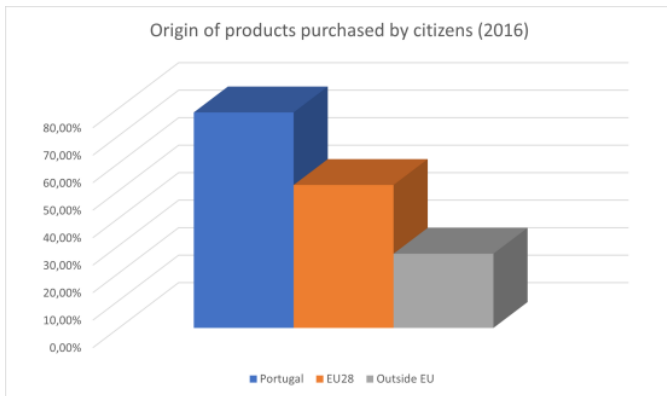

Figure 7. Origin of products bought by Portuguese citizens (2016)

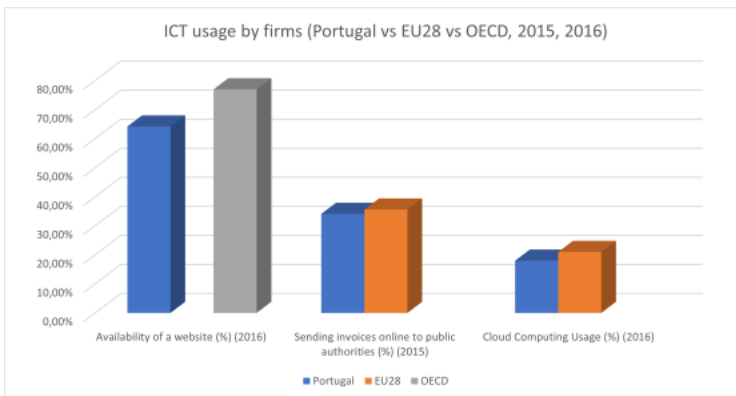

Figure 8. ICT usage by firms (Portugal vs EU28 vs OECD, 2015, 2016)

In Portugal, there is a widespread use of ICT by companies. In fact, in 2016, 96.3% of companies had broadband connection (an increase of 11.6% compared to 2010). Furthermore, it is important to note that the gap between small and medium-sized enterprises with broadband decreased by 4.8% between 2010 and 2016 (OECD, 2017j), a significant reduction and which highlights the investment that has been made by enterprises in technology.

Regarding the provision of a website, Portugal, with 64.2% of companies, is slightly below the OECD's 77.0%. If we consider companies with more than 10 employees, we find that only 17.9% of Portuguese companies use Cloud Computing, 20.5% make use of Customer Relationship Management (CRM), 8.5% perform large- -scale data analysis (Big Data), 14.5% use radio frequency identification (RFID), and 43.8% adopt Enterprise Resource Planning, a high value in relation to other European countries (OECD, 2017l).

In Portugal, in 2015, 34.1% of companies sent an online invoice to public authorities (slightly below the EU28 average (35.6%)). The use of the internet for this purpose is higher in large companies (57.2%) than in small companies (32.6%)) (OECD, 2017m).
Regarding the use of Cloud Computing, the number of Portuguese companies making use of this technology increased by 5% between 2014 and 2016, having a value of 18%. This value is still below the 21% average of EU countries. At this level, there is a large discrepancy between the 43.8% of large companies, the 28.1% of medium-sized companies, and the 15.6% of small companies (Eurostat, 2016).

As for the use of management tools in companies, this index increased by 17.8% between 2010 (26.0%) and 2015 (43.8%). Here, there is a huge discrepancy between the business fabric, ranging between 91.8% of large companies and only 37.4% of small companies (OECD, 2017o).

In turn, 13.4% of enterprises did large-scale data analysis (Big Data) in 2016 (large enterprises 23.9%, medium-sized 17.1%, and small enterprises 12.5%). The use was primarily for geolocation from mobile devices (56.6%), information generated from social media (54.4%), and data from companies' own smart devices or sensors (28.0%) (OECD, 2017p). This use is led not only by the ICT sector but also by the services sector (utilities) (particularly data from smart devices), transport (information from mobile devices), and also accommodation and food (data from social networks) (OECD, 2017q).

Finally, analysing the investment made in ICT is a good indicator of the state of a given country with regard to its technological infrastructure. Checking the EU28 countries, Portugal shows the largest decrease in this rate between 2009 and 2016, dropping from 3.24% to 1.79% of GDP, a decrease of 45%. In fact, 32% of Portuguese companies seeking ICT specialists say they have difficulties in hiring, a number above the 0.9% of total companies that was seen in 2012 (OECD, 2017r). From this indicator we conclude that the increase in demand was not accompanied by an increase in supply, but there is still a significant number of specialists in this area in the market.

Figure 9 shows the use of e-commerce by companies. As can be seen in Figure 9, Portuguese companies are still slightly below the numbers presented by both the EU28 and the OECD when it comes to Internet sales. In fact, the retail turnover of e-commerce in Portugal is much lower than that of the EU28. In terms of the use of cloud services there also continues to be a discrepancy.

Figure 10 shows the destination of products sold by Portuguese companies through e--commerce, compared to the EU28 average.

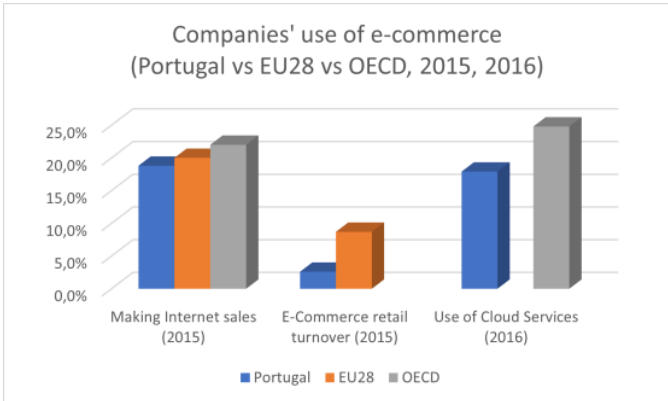

Figure 9. Companies' use of e-commerce (Portugal vs EU28 vs OECD, 2015, 2016)

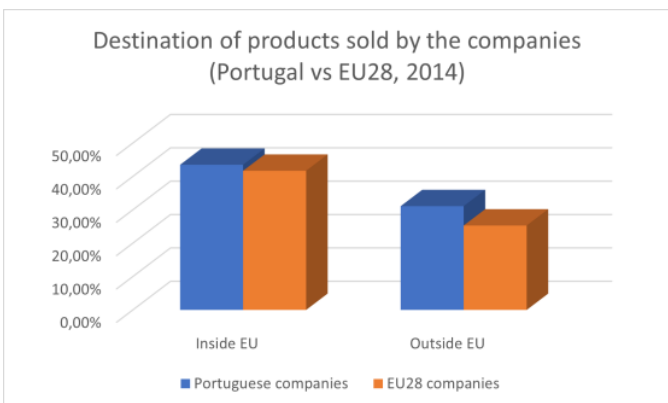

Figure 10. Destino dos produtos vendidos pelas empresas (Portugal vs EU28, 2014)

With regard to Portuguese companies that traded electronically in 2014, a high percentage sold outside the country (43.5% to other European countries and 31.1% to non- -European countries), above the EU28, with 41.7% and 25.3% respectively, with a significant increase in sales outside the Union (12.5%) (OECD, 2017x).

This increase shows above all a greater confidence of companies in this type of business, which is largely due to the improvement of e-commerce platforms, particularly with regard to security and payment guarantees.

5. Conclusions

ICT investment is important for the development of a country and the welfare of its citizens, as well as for businesses. Technology has led to an exponential increase in potential security risks (cybercrime). Cybercrime is a real and present danger that can have serious consequences for individuals, businesses, and society as a whole. The use of ICTs can pose risks to users, both in terms of their personal data and their online activity. In order to mitigate these risks, it is essential to study people's behaviour online, both individually and in the workplace.

The internet has become an integral part of people's daily lives, with a 24.4% increase in use (on average) in OECD countries between 2006 and 2016, with a value of 83.8% in 2016. This trend was also seen in Portugal, with an increase of 34.8%, which although it is a higher percentage of growth than the

average of the OECD countries is still, in absolute terms, below it, with only 70.4%. Despite this, the percentage of the youngest (between 16 and 24 years old) is very high, at 99.1%, above the OECD's 96.5%, which indicates a trend of significant improvement of the situation in Portugal in the upcoming years (OECD, 2017b). The 2019 study (Commission, 2020) found that men use the internet more than women do on a daily basis. There is also a direct relationship with age, with a substantial decrease in the over-55 age group.

There is also a direct relationship between people's economic level and daily use of the Internet (78% for people with economic stability against 61% for people with more financial difficulties). Here, the solution to increase these numbers may be to create digitalisation programmes for society that provide, for example, a minimum Internet package to the neediest citizens. This discrepancy can also be seen when comparing urban centres with rural areas (81% and 72%). This difference can also be compensated by the above-mentioned incentive programmes.

Regarding the use of cloud services by its population, in Portugal, 33.5% of internet users used these services in 2016, a growing figure (31.8% between 2014 and 2016). Among the users, those in the age group between 16 and 24 years old stood out (54.6%), which represents a favourable outlook for the upcoming years (OECD, 2017g).

In Portugal, the percentage of people aged 16-74 who used the internet to interact with public authorities in 2016 was 44.7%, below the average of OECD countries (53.8%). According to the OECD (OECD, 2017h), to the difference recorded between the various countries contributes, among other factors, the difference in the percentage of internet users and the availability of e-government services. Nevertheless, there is a great discrepancy between the various age groups, and this value, if we consider only individuals between 25 and 54 years of age, is 57.7%, which shows a very significant future evolution trend.

Portugal, despite public investments made and successive programmes created with the purpose of improving the country's competitiveness, appears to lack a centralised digital strategy, which is intended to make the country more coherent in the field of digital transformation and more harmonised with the digital strategies of other countries.

In a global scenario, where other countries are investing significant amounts in the digital transformation of companies and individuals, it is expected that Portugal should invest in the areas with the highest risk, most visible and more valued by its citizens. Portugal, which is in a phase of technological development, has to invest more in R&D and in ICT, as well as in the training and updating of digital skills. Only this way Portugal can ensure that its digital transformation is effective and that it can compete with other countries where the digital transformation of companies and individuals is well under way.

Portugal should not be worrying only about the global competition, but also about the competition of other countries in the European Union, or even in the same Eurozone. The country's competitiveness must always be associated with the country's commitment to its digital transformation. Portugal has a lot of potential, but needs to invest more in research and development, and needs to increase awareness and knowledge of ICT in order to have a greater impact globally.

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