

# Technological modernization and innovation of traditional agri-food companies based on ICT solutions – the Portuguese case study

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**Abstract:** *This paper assesses the potential for technological modernization and innovation based on Information and Communication Technologies (ICT) in traditional agri-food companies located in the central region of Portugal. A survey was applied to 50 agri-food companies of Cereals, Cheese, Olive oil, Dry sausages, Honey, Wine, and Horticultural sectors. Survey results can be summarized as: The majority of companies use computers and have Internet service. Most of companies do not have a webpage and neither use Internet for advertising campaigns, selling or buying products. Half of companies use social networks for business purposes. Most companies have not promoted the training in ICT of their collaborators in the last year. Companies claim that possessing a webpage and attending ICT training will be the technological solutions that will improve their productivity and/or marketing products and services. For each sector, recommendations and suggestions were provided in order to promote the use of ICT for business purposes. The required ICT solution was developed to a limited set of companies. The main ICT-based solutions developed were company webpages and Facebook pages. A CRM system was developed for one company. A satisfaction survey was carried out at the end of the implementation of the ICT solution. Companies' managers were highly satisfied with the ICT specific solution developed for its company and they affirmed that the company sales increased due to the web visibility gained by the company products.*

**Keywords:** ICT; agri-food industry; innovation; survey; case study.

## 1. INTRODUCTION

Nowadays, we notice worldwide, initiatives and strategies related to the promotion of widespread access and use of Information and Communication Technologies developed by several governments. (ICT), as it is seen as essential vehicle for the development of advanced services on the internet, such as e-business, e-government or e-learning. The ICT and its use have been spreading at an astonishing speed. The latest figures (December 2015) for the 28 member States in the European Union (EU28) show that 83% of households [1] (most recent data in 2015) and 93% enterprises of all dimensions [2] (most recent data in 2009) have Internet access. These values increased almost 51% and 21% respectively in a decade. 39% of EU enterprises used some type of social media (e.g. social networks, blogs, content-sharing sites and wikis) in 2015, and compared to 2013 their use strongly increased [3]. 79% of these businesses, most of small

dimension enterprises, used such applications to build their image and to market products.

According to [4], nearly two thirds of EU citizens access the Internet every day (65%), but a substantial minority (22%) say that they never use the Internet or do not have access. In 2014, the share of the population that had no experience of internet use (whether at home, at work or elsewhere) was highest in Romania (39%), Bulgaria, Greece, Italy and Portugal (30%).

As stated in [5], besides accessing the Internet from a computer (92%), 61% of Internet users access it through a smartphone, and 30% use a touchscreen tablet. More than half of Internet users in the EU say they use the Internet to access their e-mail (86%), read news online (63%), access online social networks (60%), buy goods or services online (57%) or do online banking (54%), while 23% sell goods or services. Portugal is placed in tail of the EU countries, as only 48% of citizens use the Internet daily, 34% never use Internet and 10% have no internet access. The overwhelming majority of Portuguese citizens (93%) access the Internet via the computer (EU 92%), followed by the smartphone for 38% (EU 61%) and by the tablet for 22% (EU 30%). The leading online activity is using the email (PT 82%, EU 86%), followed by the use of online social networks (PT 76%, EU 60%), reading news online (PT 67%, EU 63%), perform online banking services (PT 26%, EU 54%) and purchasing goods or services (PT 20%, EU 57%). If it is considered the use of Internet for work or business purposes, more than one in three EU citizens (38%) use the Internet while in Portugal this value is around 25%. As stated by Lehmann et al. [6], the efficiency, process control and consumer communications are all closely related to the use of ICT. Global networks, Internet, networked devices, sensors, online social networks and strategies and methodologies of communication are of prime relevance for the competitiveness and sustainable development of the food sector. Thus, ICT play a transversal role in productivity and competitiveness of agricultural production systems, agri-food, agro-industrial and forestry, as well as its shaping effects on the economic structure, social organization and sustainability of rural development. ICT are the instrument basis of the knowledge economy and allowed the development of innovative solutions in the operational management of production/transformation systems that structure the global economic system by organizing the access to increasing information flows that allow integrate multidisciplinary perspectives for the optimization of its results. The agricultural system was also covered, and concepts such as precision agriculture, sensing/monitoring, traceability, automation and robotics, market and access virtualizations, etc., have been taking increasingly the daily lives of producers and industrial sector. However, the digital gap between rural and urban areas is not only a question of coverage. It is also related to transfer speed, quality and cost. Operators cannot obtain an equivalent return between rural and urban customers.

This paper aims to identify, discuss and show examples of the transversal role of ICT solutions in the value chain of agriculture and agribusiness, in particular the optimization of resource management processes, access to markets, supply chains, dissemination of knowledge and extension services, supply of financial e-services. Additionally, it aims to show how ICT can promote the growth of value in production chains, and what their impacts on the development and sustainability of rural areas.

Given the interdisciplinary perspective, this article aims helping answer some important questions about the application of ICT in agriculture: What is the perception of producers and industrial of the agriculture sector on the usefulness of ICT in their economic activity? To what extent, the use of mobile phones and the internet has expanded/diversified the turnover in the agricultural sector? What is the degree of penetration of ICT in the daily lives of producers and industrials of the agricultural sector? Is the everyday life of producers and industrials affected by the adoption/indifference/rejection of ICT in their economic activity? Are there differences in the level of ICT adoption depending on the agriculture sector that is considered, i.e., meat, fish, horticultural, and others? The systems and scales of production affect the adoption of ICT? Are the age stratum and socio-economic level of the users, barriers/facilitators for the incorporation of ICT in the daily life of their economic activities? The yield, well-being and quality of life of the producers and industrials of the sector has changed with the adoption of ICT? What are the effects observed in the agricultural sector in terms of employment, productivity and competitiveness? There is evidence of greater sustainability in rural development by adopting ICT? Which are? How to promote these transformations?

This paper tries to answer these questions by discussing the assessment and application of ICT solutions in agri-food companies and businesses. The paper is divided mainly in two main parts. The first part is devoted to the study concerning the assessment of the potential of the technological modernization and innovation in strategic and traditional sectors based on ICT, specifically of the agri-food sector. This part is organized as follows. Section II describes the framework of the study. The state-of-the-art on the evaluation and application of ICT in the food sector and/or rural areas is described. The main objectives of the project that includes the assessment provided by this study are pointed out. Section III presents the materials and

methods used to develop the analysis of the potential for technological modernization and innovation based on ICT in agri-food companies of the central region of Portugal. The sequential steps that compose the methodology followed are described. The procedures for the questionnaire construction and for the survey implementation are presented. Section IV includes the results from the compilation of the questionnaire answers and its analysis and discussion. Section V gathers the suggestions and recommendations that identify improvement opportunities arising from the cross analysis in all sectors.

The second part of the paper is related to the implementation of ICT solutions in selected companies and the analysis and discussion of the results. Section VI describes the ICT solutions implemented in a set of agri-food businesses in traditional sectors, such as the creation of webpage or Facebook pages, the configuration of Customer Relationship Management (CRM) software, among others. Section VII discusses the business improvements due to the implementation of ICT solutions and the evaluation and measurement of the influence of ICT in the competitiveness and economic growth of the companies. For last, Section VI describes the main conclusions of the study.

## 2. FRAMEWORK

One possible path to leverage the economic activity of food companies, in face of the economic recession installed, is to encourage the use of new technologies in small and medium enterprises (SME) of strategic and traditional sectors.

Lehmann et al. [6] provide an overview on the state-of-the-art in three use cases within the application domain of the food sector. The first case deals with management support for farming and the provision of appropriate IT support. The second one with logistics that might include aspects such as customer service, transportation, storage, plant site selection, inventory control, order processing, distribution, procurement, materials handling, return goods handling and demand forecasting. The last case focuses on the awareness, i.e. on the detailed information of food products and the proper communication to present and sell these food products. It focuses on the state-of-the-art on technology (networked devices and networks for communication), information content, organization and collection as well as data exchange and interoperability. The authors concluded that the major interest in farming is in production control. The major interests in logistics are data transfer and communication of information between stages of the chain related to tracking and tracing, monitoring of movements, product quality, and environmental impacts. In awareness, the major interest is in communication with consumers. Some studies covered these use cases, from the implementation of new ICT [7-9], the proper determinants used to assess the ICT usage [10-11] and surveys on rural areas to determine the ICT usage. Botsiou and Dagdilelis [12] developed a study to evaluate the ICT profile of 29 farms in the northern region of Greece using a semi-structured interview process. They were not interested in evaluating whether a computer was available with an Internet connection for the needs of rural enterprise, but whether if it was used, for what purpose and in what way. The results of the research lead to the revelation of four kinds of ICT profiles in modern rural enterprises and a way of covering the ICT skills gaps of the farmers, via social environment.

Sturiale and Scuderi [13] provide some indications about the involvement of social networks into the agri-food system. An online survey was applied to 500 followers of a page in the Facebook social network. The results predict an increase of social commerce and that enterprises need new forms of collaboration with consumers, especially within the online environment based on tools and interaction models as well as online platforms.

Moghaddam & Khatoon-Abadi [14] identified the factors influencing the adoption of ICT in a rural ICT center of an Iranian province. The survey was applied to 218 individuals. Based on the results, the existence of an ICT center reinforces the adoption of ICT regardless of the users' economic status. At the same time, factors such as individual, social, the households' informative & communicative, as well as the innovation related factors were found influential on the use of ICT.

Senthilkumar et al. [15] performed a survey on 270 respondents comprising of 180 users and 90 non-users of Village Information Centers (VIC). A multiple linear regression analysis was applied to assess the factors associated with the VIC usage level in the study area. The study concluded that dairy farmers with higher land-holding size and dairy herd size need good knowledge on dairy farming, so they are more likely to use VICs. Higher usage levels of VIC information contribute to knowledge gain, which in turn contributed to the effectiveness of VICs among the users.

Zhang et al. [16] provide a comprehensive review and analysis of seven ICT based information dissemination models (1: web portal, 2: voice-based service, 3: text (SMS)-based service, 4: self-support

online community, 5: interactive video conferencing service, 6: mobile internet based service, 7: unified multi-channel service model). Model 1, web portal, consists in using web pages to disseminate information while Model 6, consists in the mobile Internet technology. Model 7 considers all the relevant technologies. The latter model is the current application trend in China.

Ali & Kumar [17] analyse the role of information delivery through ICT in enhancing decision-making capabilities of Indian farmers. They concluded that the use of ICT improves significantly the decision-making aptitudes on various agricultural practices across the agricultural supply chain. Their study emphasizes the importance of designing ICT enabled information systems to suit the socio-demographic profile of the user groups. This is also a viewpoint shared by Ugwoke [18] that highlights the problems associated with information dissemination to farmers. As the previous authors, he concludes that better agricultural practice and high associated yields can be achieved by the use of IT. This conclusion is very important amongst the users of our study.

Nguyen & Burgess [19] discuss the numerous issues regarding to the management of the knowledge in small businesses. Their approach focus on how knowledge is transferred between individuals and between small business owners/managers and employees. They suggest how this process should be conducted. This context is also discussed by El Kadiri et al. [20] that describe the major contributions and research orientations of ICT technologies. They propose a set of recommendations as a perspective towards next generation of information systems. Additionally,

Therefore, the use of ICT by incorporating innovative features with added value, improving the skills of SMEs activity and promoting the modernization of regional business sector will foster the economy and competitiveness of agri-food traditional sectors. Thus, there is the need for an urgent intervention. The project MITTIC - Technological Modernization and Innovation based on ICT in strategic and traditional sectors was proposed to help assisting this need. This European project aimed to promote the economic growth and the employment by increasing competitiveness in economic, strategic and traditional sectors in the regions of Extremadura region of Spain and Centre and Alentejo regions of Portugal. This objective was accomplished by proposing and implementing innovative models of organization and production processes based on ICT solutions. The project had the following strategic objectives:

- Increase the innovative capabilities in terms of ICT: through improved management of knowledge, based on shared structures that optimize the resources in Research, Development and Innovation (R&D&I) and which allow joint requirements and opportunities to be identified.
- Update traditional productive sectors in terms of technology based on natural and strategic resources, by applying new business models or improving existing ones based on knowledge and ICT.
- Exchange new applications, processes or valuing methods for products with productive sectors by means of ICT, to generate new opportunities for business or to promote business innovation in those that currently exist.

The project consortium was constituted by twelve partners, seven from Spain and five from Portugal.

### **3. ASSESSMENT OF THE POTENTIAL OF TECHNOLOGICAL MODERNIZATION AND INNOVATION**

The first activity of the project was the analysis of the potential for technological modernization and innovation based on ICT. This activity aimed to develop an in-depth analysis of the use, introduction and adoption of ICT in manufacturing and sales processes in strategic and traditional sectors in Extremadura region of Spain and Centre and Alentejo regions of Portugal. A technological research of businesses in this sector on both sides of the border was carried out. This paper presents the results of the survey on the use of ICT tools for manufacturing processes and for support, marketing and sales in order to assess the potential for technological modernization and innovation based on ICT. The survey was applied to 50 agri-food industrial companies belonging to Cereals, Cheese, Olive oil, Dry sausages, Honey, Wine and Horticultural sectors located in the central region of Portugal. This analysis of the results assessment allowed to recommend and suggest solutions to increase the introduction and use rate for ICT tools in companies of each sector in order to improve their manufacturing and marketing processes. Furthermore, it provided support, guidance and backing for the businesses being studied to introduce and implement support, marketing and sales tools. These recommendations and suggestions were applied to a set of companies to evaluate the influence of ICT in the competitiveness and economic growth of agri-food traditional sectors.

## 4. MATERIALS AND METHODS

The methodology for analysis of the potential for technological modernization and innovation based on ICT in agri-food industrial companies of the central region of Portugal followed three sequential steps:

- Step 1 - Definition of the sample;
- Step 2 - Script structuring and construction of the questionnaire;
- Step 3 - Conducting interviews.

### 4.1. Definition of the sample

The definition of the stratified sample required the following tasks:

- Identification of the different sub-sectors of the traditional agri-food sector with greater representation in central region of Portugal.
- Selection of the traditional agri-food companies for the sample (provided by the InovCluster - Association of Agro-Industrial Cluster of the Centre region of Portugal) [21].
- Selection of alternative companies, to ensure in proper time, any failure or refusal response by the respondents of the pre-selected sample.
- Survey and validation of telephone and email contacts of the sample.

Table 1 shows the traditional agri-food sectors evaluated, the number of companies surveyed in each sector, as well as the range of variation of some data of these companies, such as the number of workers and turnover. The sector that contributed with most companies to the survey was the Cereals sector, followed by the Cheese sector. Only two companies from the Horticultural sector participated in the survey, so the results for this specific sector are very limited.

Table 1. Details of the industrial companies surveyed.

Sector	No. of companies surveyed	No. of workers		Turnover [m€]	
		Min	Max	Min	Max
Cereals	15	1	5	2.5	100
Cheese	9	1	5	50	800
Olive oil	9	1	5	7	120
Dry sausages	8	2	5	50	600
Honey	7	1	3	1	50
Wine	5	1	5	1	100
Horticultural	2	1	3	50	

As shown in Table 1, most companies have between 1 and 5 workers, so they have a small dimension. In the case of a single worker, this person is at the same time the owner, the manager, and the worker who uses ICT. Note that the turnover range is limited to the information provided by the companies. Many of the companies that participated in the study did not provide this information.

### 4.2. Script structuring and construction of the questionnaire

This step involved the definition of the screenplay for personal/telephone interview, supported by a number of issues directly related to readiness for the use of ICT tools. The questionnaire was composed by 50 questions about the following topics:

- Company information.
- Use of ICT and Internet access.
- Use of Internet and online social networking.
- E-commerce.
- ICT training.
- Other concepts.

After the end of the inquiry process, the database where replies were loaded was built automatically by the online application used. After loading the 50-person/telephone questionnaire results, data was exported in CSV format (Coma Separate Values) compatible with spreadsheet software.

### 4.3. Conducting interviews

This step focused on the face and telephone interview process. In order to proceed rapidly with the face interviews, the team responsible to perform the live interviews was composed by two duly qualified elements, which received specific training for this purpose. At first, a session for presenting the study objectives was performed, simulating the interview (identifying potential constraints in getting some answers) and the procedures required for loading the surveys in the online application (ensuring a permanent monitoring of fieldwork). Subsequently, results monitoring ensured the accuracy and quality of information obtained.

The live/telephone inquiry process took place between November 1 and December 15, 2014, resulting in 50 interviews validated. The main constraints to conduct the interviews were:

- Specificities of some sectors concerning the work period (night or all day in the field) making it difficult to conduct telephone calls or arrange scheduling.
- Reduced sensitivity to the issues raised, as the business environment in these sectors, with many family farms, demonstrates a strong detachment or perception of the issues involved (low qualifications and age of responsible/workers).

## 5. RESULTS AND DISCUSSION

The compilation of questionnaire answers is described in this section. Only the most relevant data is presented, compared between sectors and discussed. The data is subdivided by the topics that structured the script. The results (positive answers) are presented as percentage to allow the subsequent comparative analysis of the results. It is important to highlight that the Horticultural sector is characterized by the results of two questionnaires, which reduces its validity.

### 5.1. Use of ICT and Internet access

Figure 1 shows the availability of a collaborator responsible for ICT area in the traditional agri-food companies. Most of the companies have no one in charge for this area, although the large majority (90%) uses regularly ICT equipment as shown in Figure 2a.

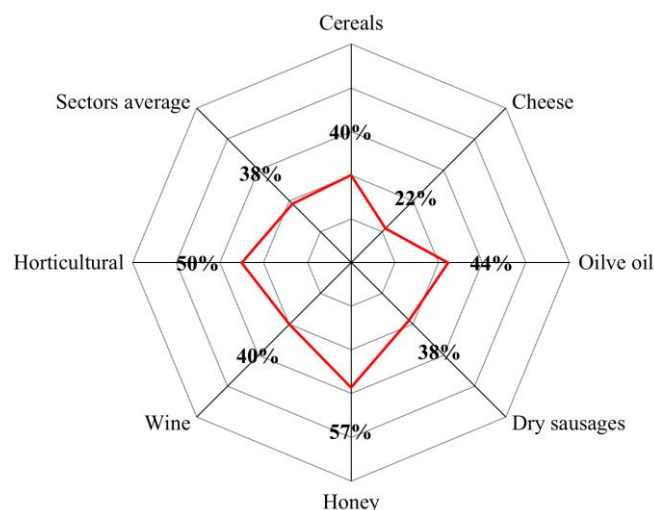


Figure 1. Availability of a collaborator responsible for ICT area.

Similar to the data obtained in the EC survey [5], the computer is the usual equipment used to access Internet, although smartphone (24% in comparison with EU 61%) and touchscreen tablet (18% in comparison with EU 30%) are also used (see Figure 2b). The companies that answer negatively to this question pointed reasons such as: lack of training, high cost, no need for the business.

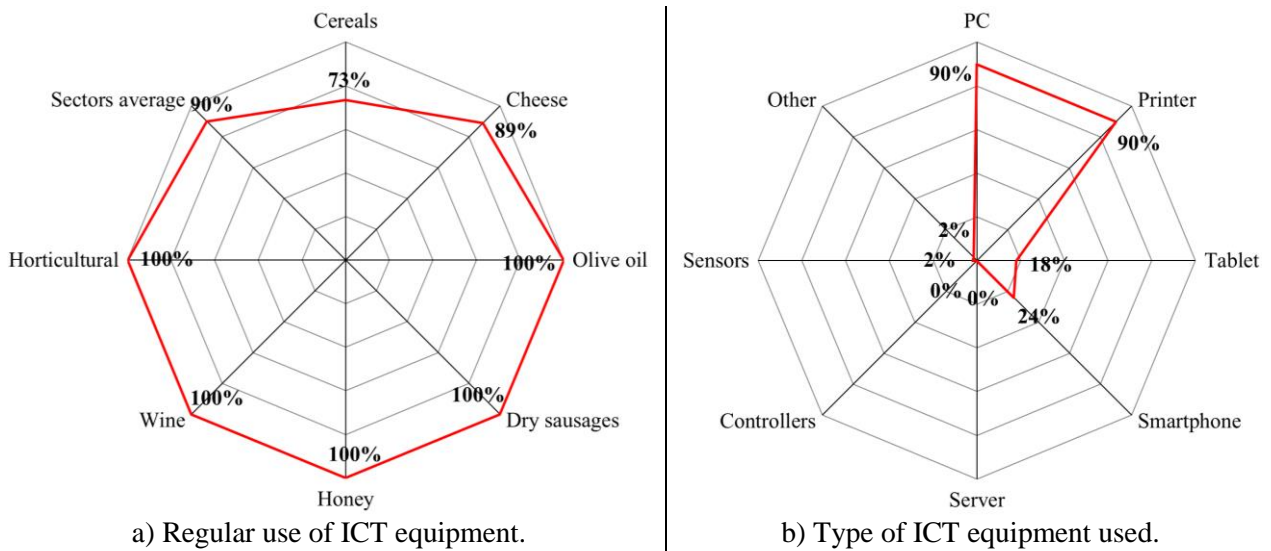


Figure 2. Usage frequency and type of ICT equipment.

As shown in Figure 3, most of the companies have Internet service. Companies of Cereals and Cheese sectors show values below the average. Concerning the use mobile devices with Internet connection, fewer companies from the agri-food sector use this ICT. Only 20% of the surveyed companies from the Cereals use it (see Figure 4a). For the companies that use it, most of them (62%) use this feature for web navigation (62%) and access e-mail account (64%). The use of this feature for financial or industrial management applications is still reduced as shown in Figure 4b.

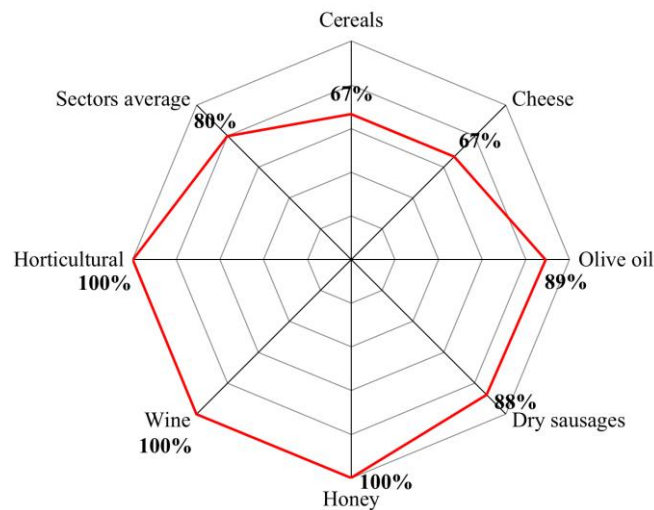


Figure 3. Availability of internet service.

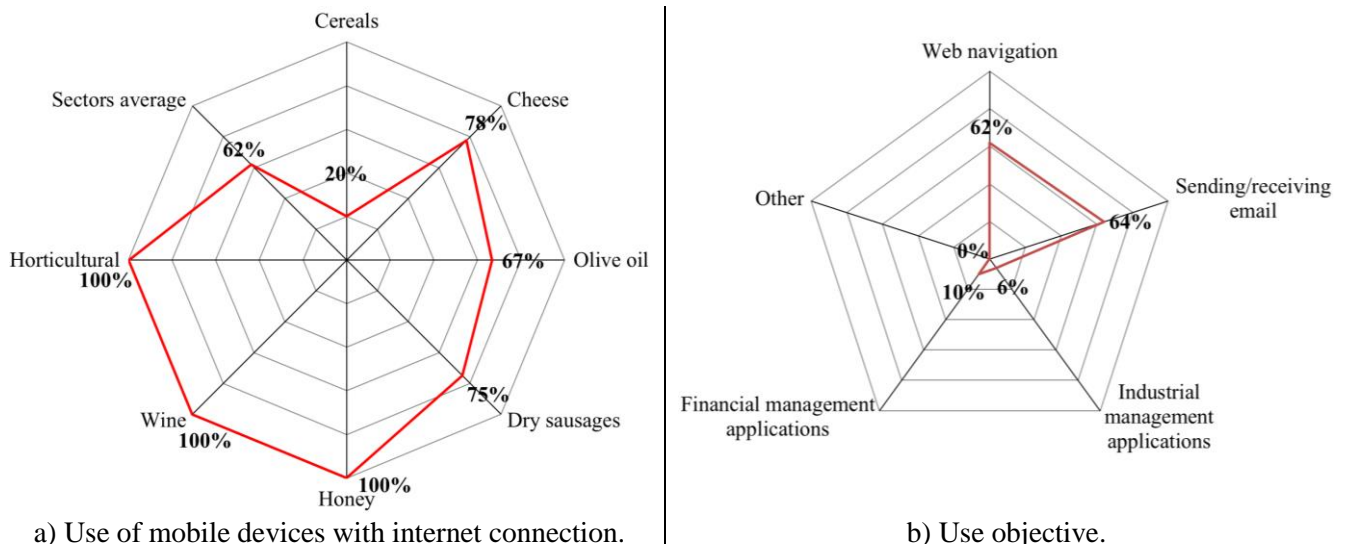


Figure 4. Use of mobile devices with Internet connection.

Most companies do not have a Local Area Network (LAN) in their facilities (60%). However, most of companies do have a corporate email address (68%).

As shown in Figure 5a, most companies use regularly ICT tools for financial management (72%), although almost exclusively they use invoicing tools (72%). Thus, other ICT tools such as accounting tools and online banking are not usually used as shown in Figure 5b. Most of companies belonging to the Honey sector do not use these ICT tools (71%).

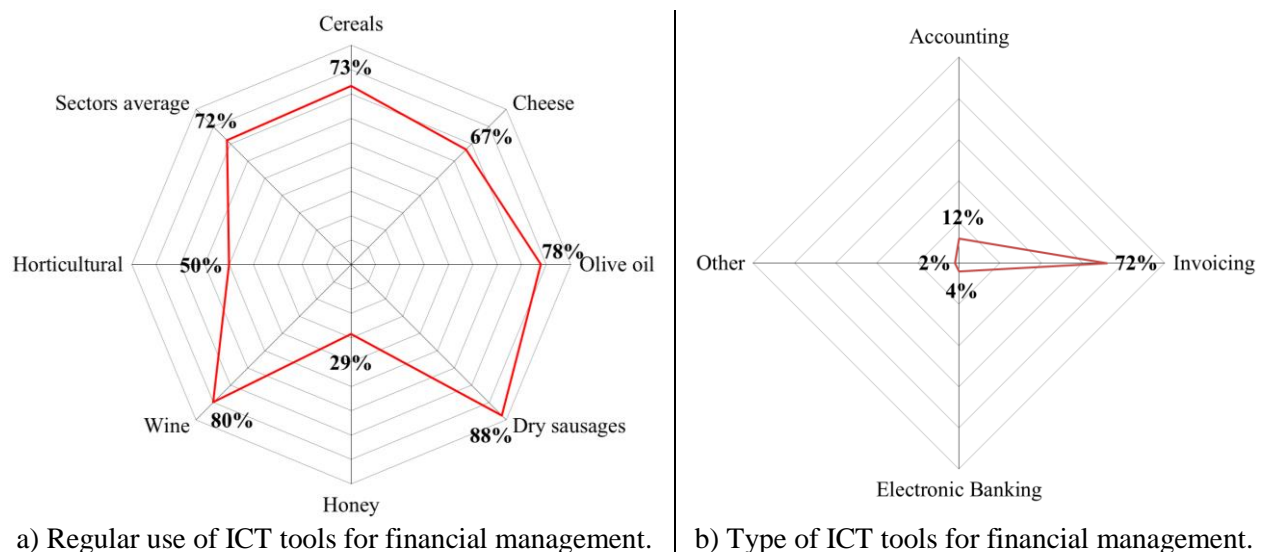


Figure 5. Use of ICT tools for financial management.

As shown in Figure 6, less than half of companies regularly use Customer Relationship Management (CRM) systems to support tasks of buying analysis or planning sales (45%). The majority of the companies belonging to the Cheese sector do not use this type of system (89%). Additionally, only one of the companies surveyed uses Enterprise Resource Planning (ERP) software. 84% of companies expressed that they have processes oriented for quality management related with:

- Hazard Analysis and Critical Control Points (HACCP) required by Food Safety standards.
- Standard ISO 9001.
- Biological certification.

Additionally, 80% of companies stated that they use tools for products traceability. However, most of the tools used are not based in ICT.



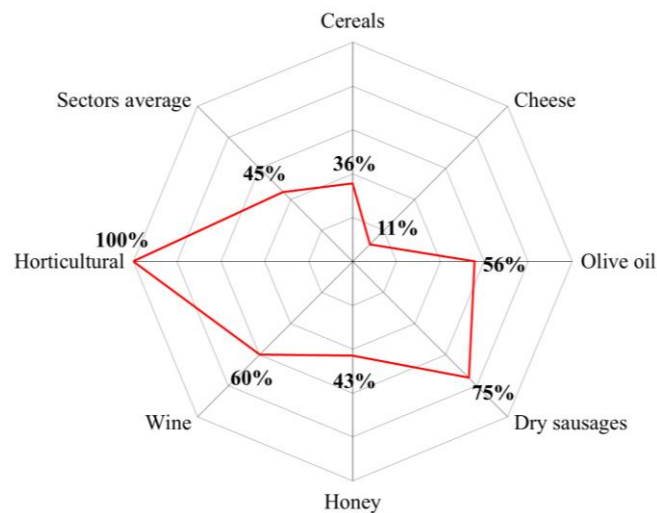


Figure 6. Regular use of a CRM system.

The following question focused on the use and knowledge of computer security services to protect the ICT from cybercrime. 86% of companies claimed to use of a security service such as Antivirus and Firewall. Safety copies, authentication mechanisms and secure servers are not usual security services used by the companies. Nevertheless, these concerns about cybercrime are reflected in spreader use of online security tools as anti-virus software when compared with the results of EU, where 61% of the Internet users changed their online behavior due to security concerns [5].

### 5.2. Use of Internet and online social networking

Figure 7a shows the percentage of companies that have a webpage. Most of the companies do not have it (24%). Only half of companies of Dry sausages and Horticultural sectors have webpages. For the other sectors, the availability of a webpage is even more reduced. However, most of the companies are interested in creating a webpage in the near future (44%) as shown in Figure 7b. However, there are still companies that claim not to need a company webpage (20%).

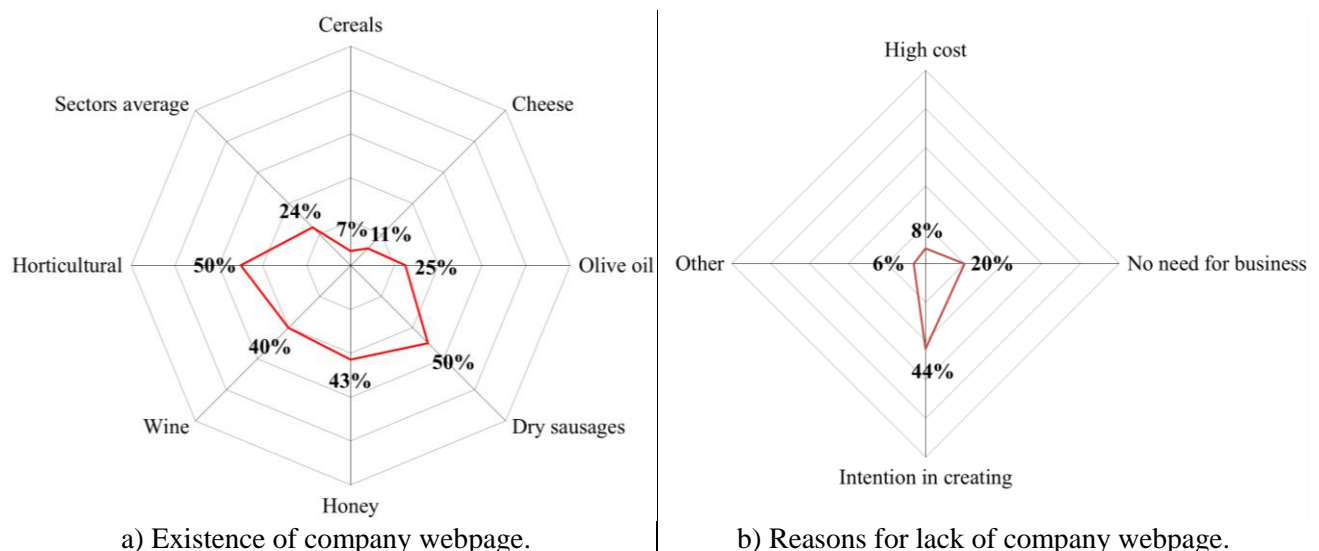
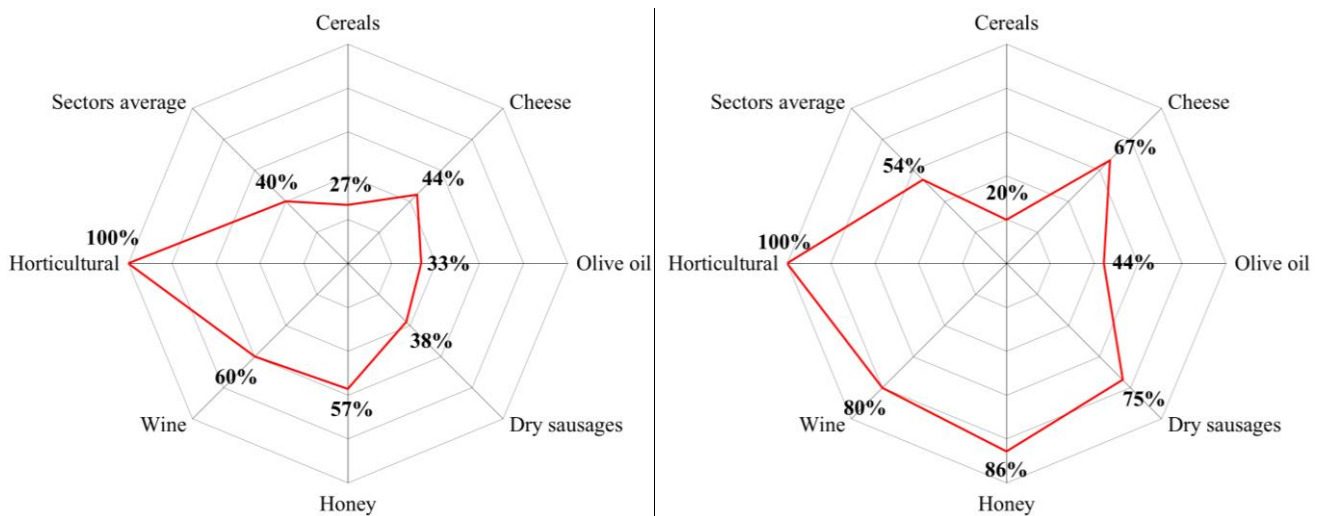


Figure 7. ICT solution: webpage.

Most companies do not perform advertising campaigns through the Internet (60%). However, companies belonging to Honey, Wine and Horticultural sectors perform these type of campaigns (see Figure 8a). As shown in Figure 8b, half of the companies make use of social networks, mostly Facebook, for business purposes (54%). There are a reduced number of companies of the Cereals sector performing this activity. The companies that provide a positive answer claim that online social networks are used as a consumer

information channel and as vehicle to promote company marketing. Additionally, half of the companies make use of social networks to search for suppliers and customers (43%).



a) Promotion of advertising campaigns via Internet.

b) Use of social networks for business purposes.

Figure 8. Use of ICT solutions for promotion and business.

### 5.3. E-commerce

Most companies do not sell products online (74%) as shown in Figure 9. The companies belonging to the Cereals, Olive oil and Dry sausages do not make use of this potential use of ICT. In the same sense, most companies do not purchase products for business over the Internet (68%) and half of the companies do not perform markets research over the Internet (52%).

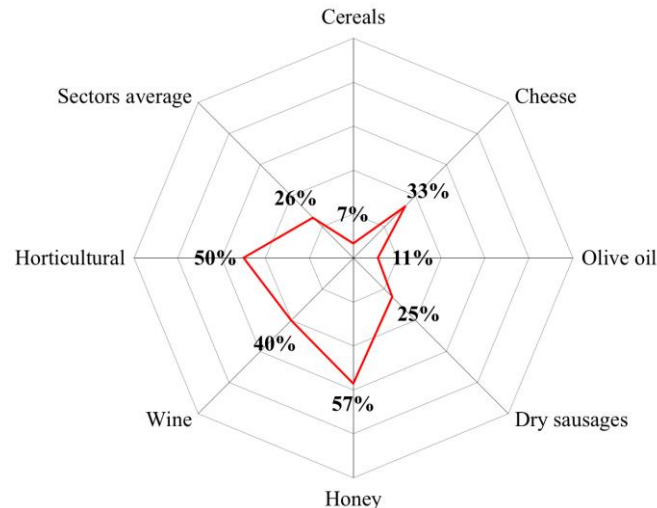


Figure 9. Companies selling products via Internet.

### 5.4. ICT training

Figure 10 shows the investment of agri-food companies in ICT training during the last year. The training of company collaborators during the last year in ICT is reduced in all agri-food sectors (26%). Cereals, Honey and Wine sectors did not encourage its collaborators to improve their knowledge and skills in ICT.

The ICT training performed on the companies during the last year focused the following topics:

- Office tools (text processor and spreadsheet).
- Applications for company specific systems.
- Enterprise management tools.

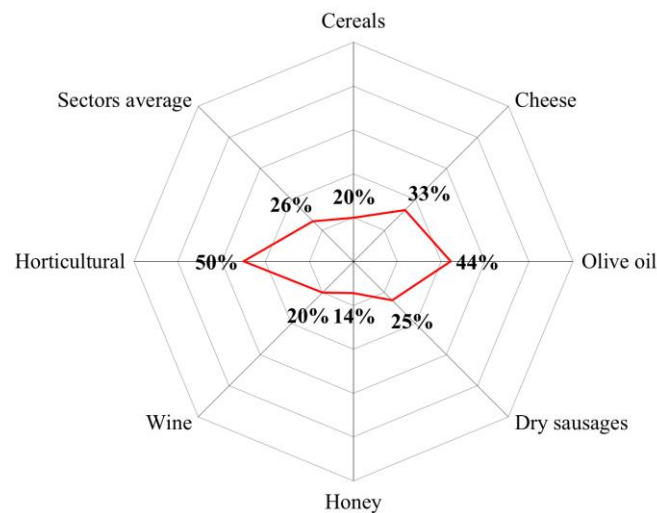


Figure 10. Training in ICT for company collaborators in the last year.

### 5.5. Other concepts

The last question of the questionnaire asked owners, managers and workers of agri-food companies what are the equipment and/or technological solutions that may improve the company productivity and/or marketing of products and services. The overall answers are shown in Figure 11. 55% of companies think that possessing a company's webpage will improve company productivity and/or marketing of products and services. In addition, 41% of companies reveal that these objectives may also be accomplished providing ICT training to their collaborators.

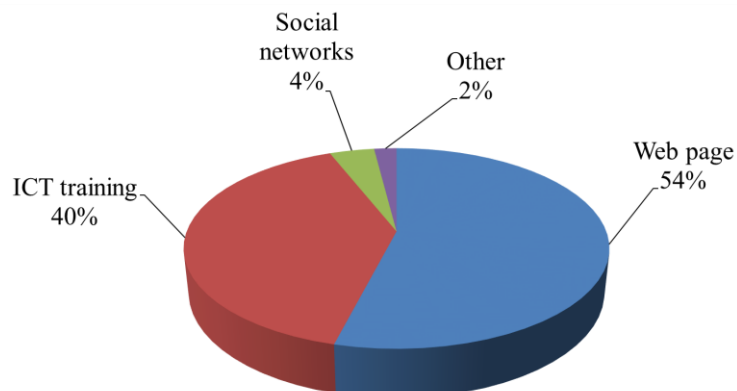


Figure 11. Equipment and technological solutions to improve productivity and/or marketing of products and services.

## 6. SUGGESTIONS AND RECOMMENDATIONS

From a detailed analysis per sector, it turns out that the ICT usage is at approximately similar level. Thus, the following suggestions and recommendations that identify improvement opportunities arising from this analysis cross all sectors.

First, it is recommended to promote ICT training among company collaborators, specifically to who is in charge of management and finances in these micro and small companies. This training will promote the visibility of the company and foster e-commerce. The main objective is to make the owners/managers of these companies aware for the potential that the "virtual world" can offer to their businesses.

This objective can be accomplished pursuing the following recommendations:

- Creating the company webpage to promote visibility of the company and to perform advertising campaigns through the Internet and online product sales.
- Promoting ICT system upgrade in order to implement internal networks, which encourages setting corporate email and improves the communication between company employees. Thus, it is also recommended to assign the ICT responsibilities to a trained collaborator.

- Promoting the use of financial management tools, not only invoicing software. There are several suitable freeware tools for companies that do not want to affect more costs to this area.
- Promoting the use of Customer Relationship Management (CRM) systems.
- Promoting the use of Enterprise Resource Planning (ERP) systems.
- Promoting the use of ICT tools in the process-oriented quality management.
- Promote the use of ICT tools in product traceability.
- Creating a company account on online social networks to promote the company's products.

This analysis provides a technological assessment of ICT that may help achieving more modernization and technological innovation in the traditional and strategic sectors. However, not all companies are suited to apply this set of recommendations. The suggestions and recommendations in terms of ICT tools application will depend on the specific characteristics of the company. Thus, it is necessary an in-situ analysis to the manufacturing and marketing processes in order to determine the particular conditions that can be improved using ICT tools.

## 7. APPLICATION OF ICT SOLUTION

The results analysis of the survey applied to 51 traditional agri-food companies in the Central region (Portugal) on the assessment for their technological modernization an innovation based on ICT, allowed to identify a number of opportunities for improvement that are believed to have cross-impact on the agri-food sector. So, a limited number (thirteen) of agri-food companies in traditional sectors were supported on ICT, from web page creation process, Facebook pages to CRM configuration, in order to boost their online sales. The consequent results of the companies are analyzed to evaluate and measure the influence of ICT in the competitiveness and economic growth.

### 7.1. Companies' ICT status and needs

Table 2 gathers the ICT status and needs of each agri-food company belonging to different traditional agri-food sectors that participate in the study. The table describes if the company uses regularly a CRM system; if it has webpage; if it uses social networks (Facebook and other) for business purposes and if it carries out advertising campaigns using the Internet.

Table 2. ICT status and needs of agri-food companies of traditional sector participating in the study.

n.º	Agri-food sector	CRM	Website	Social networks	Advertising via Internet
C01	Dairy (cheese)	N	N	N	N
C02	Dairy (cheese)	N	N	Y	Y
C03	Dairy (cheese)	N	N	N	N
C04	Dairy (cheese)	Y	N	Y	Y
C05	Dairy (cheese)	N	N	Y	N
C06	Dairy (cheese)	N	N	N	N
C07	Honey	Y	N	N	N
C08	Honey	Y	Y	Y	Y
C09	Honey	N	N	N	N
C10	Honey and sweet jams	Y	N	Y	Y
C11	Meat (cured sausages)	N	Y	N (outdated)	-
C12	Horticultural	Y	N	Y	Y
C13	Wine	N	Y	Y	Y

Legend: (Y) Yes, (N) No.

### 7.2. Companies' ICT solution

Table 3 shows the ICT solution developed to improve the competitiveness and economic growth of each agri-food company of traditional sector participating in the study.

Table 3. ICT solution developed for the agri-food companies of traditional sector participating in the study.

n.º	Agri-food sector	ICT solution
C01	Dairy (cheese)	(1) Company's Facebook page.
C02	Dairy (cheese)	(1) Company's website.
C03	Dairy (cheese)	(1) CRM system. (2) Company's webpage. (3) Improvement of the company's Facebook page.
C04	Dairy (cheese)	(1) Company's webpage.
C05	Dairy (cheese)	(1) Company's webpage.
C06	Dairy (cheese)	(1) Company's webpage.
C07	Honey	(1) Company's webpage. (2) Improvement of the company's Facebook page.
C08	Honey	(1) Improvement of the company's webpage.
C09	Honey	(1) Company's webpage.
C10	Honey and sweet jams	(1) Company's webpage.
C11	Meat (cured sausages)	(1) CRM system. (2) Improvement of the company's Facebook page.
C12	Horticultural	(1) Company's webpage.
C13	Wine	(1) CRM system.

The manager of Company C01 allowed the creation of the company's Facebook page (<https://www.facebook.com/tapadadassortes/?fref=ts>). An access to the personal account of company responsible was required to create the company's Facebook page associated to that user. The company C02 was supported in the development of a website to supplement the advertising campaigns performed through Facebook and to reach out their potential customers (<http://quintadocapile.pt/>).

The Company C03 did not used any type of ICT solution. Therefore, in order to start advertising products through the internet, the manager choose to be supported with the creation of a web page ([www.http://saboresdasoalheira.pt/](http://saboresdasoalheira.pt/)). The manager requested a webpage available in two languages, Portuguese and English. A multi-page structure was developed with a minimal and clean design, focusing on the UX (user experience) and use on mobile platforms. The webpage of company C04 was also created to better disclosure the products and consequently to reach more customers (<http://casaagricolacabecocarvao.pt/>). The ICT solution for Company C05 was the development of the webpage (<http://queijariacasadomorgado.com/>). In regards to Company C06 (<http://queijariaabreu.pt/>), the respective webpage was developed since it manager mentioned that the company' productivity and/or commercialization of products and services could be improved by disclosure them in the webpage. Figure 12 shows the ICT solutions developed for the companies of the dairy (traditional cheese) sector.

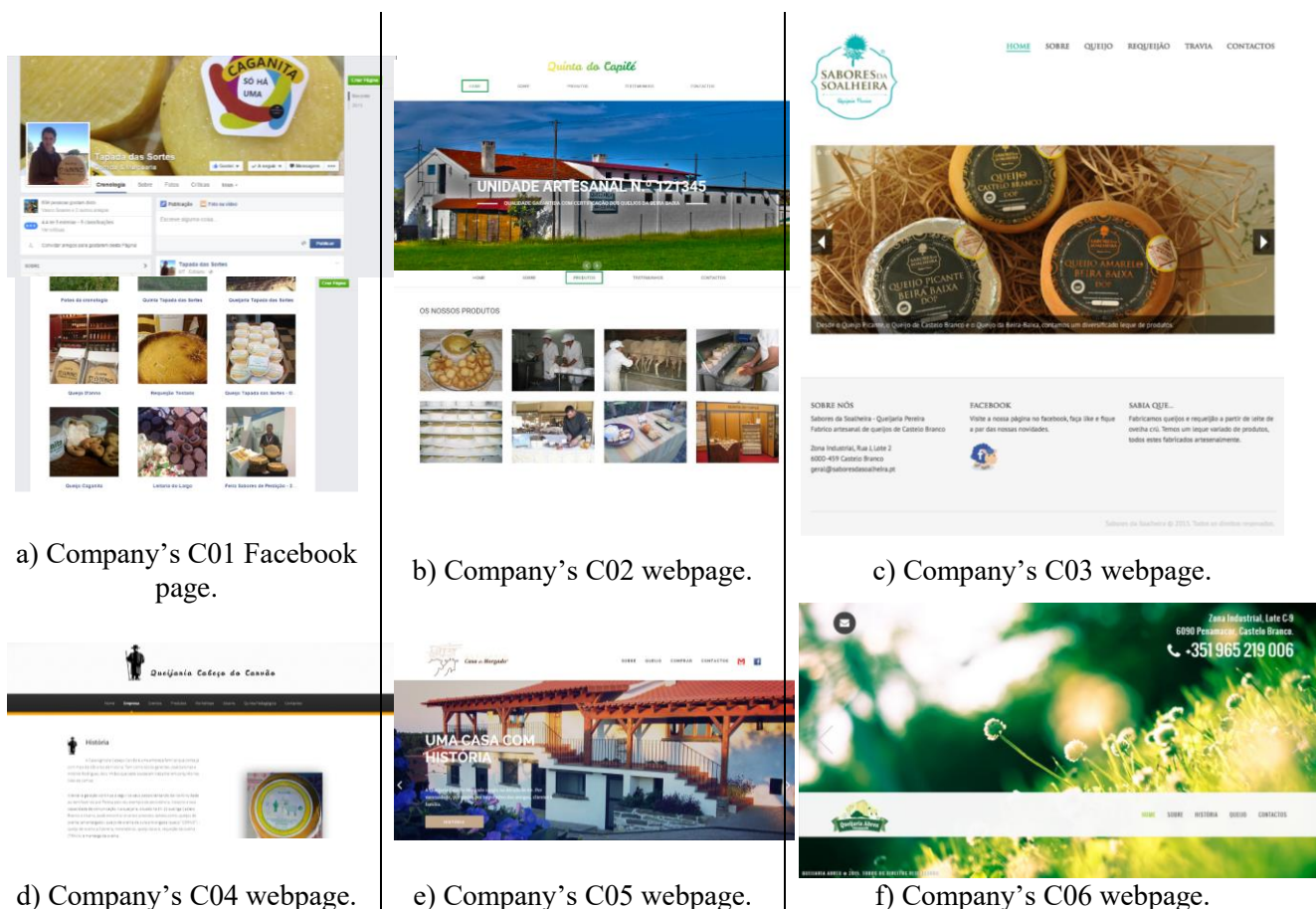


Figure 12. ICT solutions developed for the companies of the dairy (traditional cheese) sector.

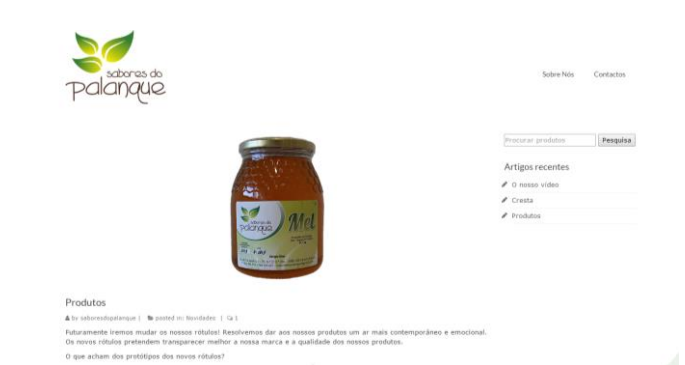
Company C07 already uses one of the recommended ICT solutions. The manager choose to be supported in the improvement of the Facebook page ([https://www.facebook.com/claros.pt?ref=aymt\\_homepage\\_panel](https://www.facebook.com/claros.pt?ref=aymt_homepage_panel)). Once the webpage of company C08 (<http://saboresdopalanque.pt/>) already existed, the company intended to be supported in few changes to the webpage, in particular, the correction of some text, removing and adding some photos of their products and also adding a newsletter.

Likewise Company C06, the ICT solutions for Companies C09 and C10 (<http://doceassaberes.pt/>) consisted in the development of the companies webpages, since it managers pointed the same reasons that lead to the development of these ICT solutions. Figure 13 shows the ICT solutions developed for the companies of the honey sector.

Among the possible ICT solution for Company C11, the manager chosen the creation of a Facebook page of the company (<https://www.facebook.com/Enchidos-Malpica-do-Tejo-982437265111567/>) to show products and it production, as well as the pictures of participation in fairs and events. Since the responsible had no personal Facebook account, it was necessary to first create a profile and then create a company page. The results is shown in Figure 14.



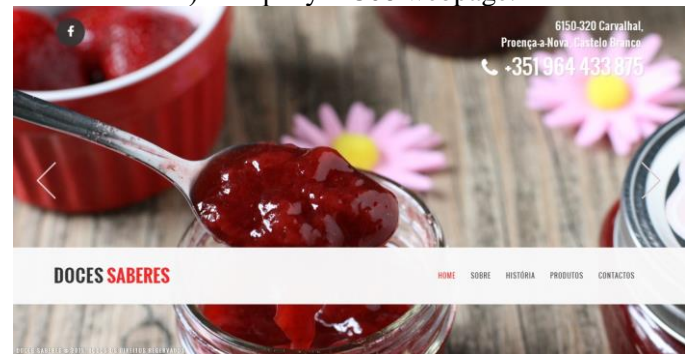
a) Company's C07 Facebook page.



b) Company's C08 webpage.



d) Company's C09 webpage.



e) Company's C10 webpage.

Figure 13. ICT solutions developed for the companies of the honey sector.



Figure 14. ICT solution developed for the company of the meat (cured sausages) sector.

The webpage of company C12 was created to show the company's history, products and contacts. The websites of companies (C02, C03, C04, C05, C06, C09, C10, and C12) were created using HTML5 technology, CSS3 (Bootstrap framework and Font Awesome), JavaScript (jQuery). The homepage of the Company's C12 webpage is shown in Figure 15.



Figure 15. ICT solution developed for the company of the horticultural sector.

The Company C13 choose to be supported in the development of a CRM system. The development of the CRM system required the organization of the following data: Contacts; Organizations; Opportunities; Home; Reports; Projects; FAQ; Calendar; Leads; Documents; email campaigns; Social module; Forecasts; builder module; Recycling; and Label Editor. A window of the CRM tool is shown in Figure 16.

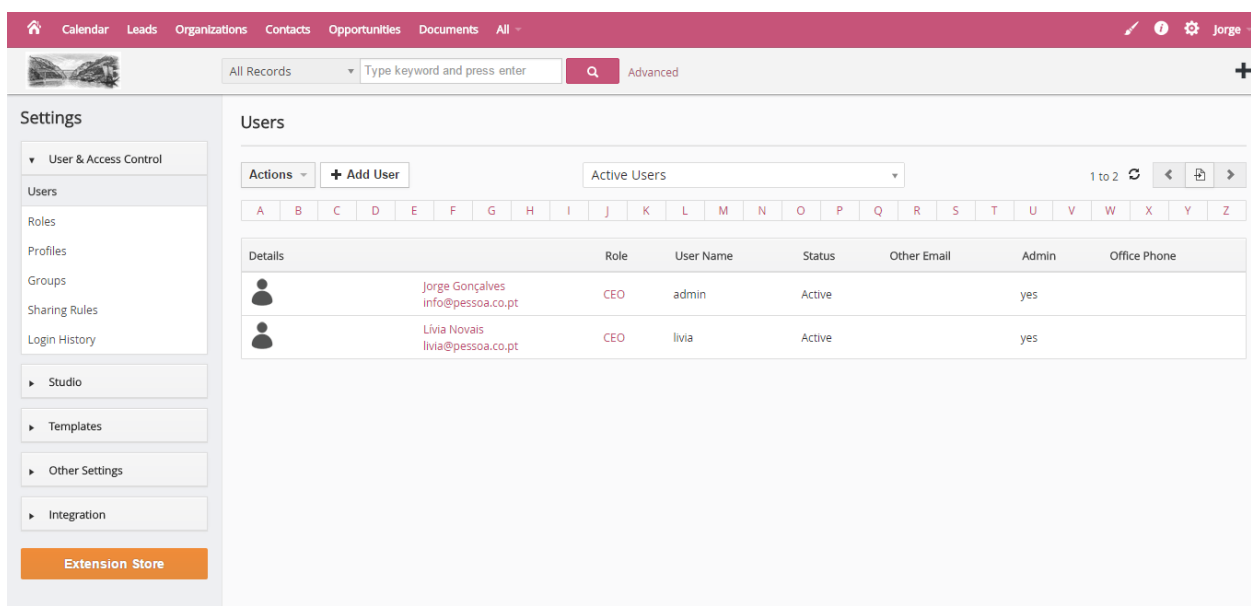


Figure 16. ICT solution developed for the company of the wine sector.

As output of the project, several webpages, Facebook pages, and CRM tools were developed or improved and configured, in order to boost the online sales of a set of agri-food companies belonging to traditional sectors. It was intended that in the course of this activity improving the ICT of at least 25 of the 51 companies where the survey conducted under the Activity 1 was conducted. However, most companies did not show interest to cooperate and proceed with the implementation of ICT improvements. The main argument pointed out by the companies' managers was the lack of time. It is worth mentioning that even though interventions at the level of the production process and the introduction of support tools in some of its modules (accounting, logistics, and human resources) were planned, the companies expressed particular



interest in the development of webpages and Facebook, and only one of which required setting up a CRM system. The major constraint pointed out was the time required to setting up the ICT improvement that took significantly longer than originally planned, mainly due to delays in collecting data process, information needed and validation of implementations. It is considered that so far interesting results have obtained, which sustain the reasons to further proceed with this kind of support in agri-food companies. The thirteen companies intervened expressed full satisfaction with the ICT solution. Figure 17 shows the satisfaction survey results on the ICT solution that was developed. The satisfaction survey analyzed four main topics: (a) Overall image of the organization responsible for the development of the ICT solution; (b) Involvement and participation; (c) Accessibility; and (d) Products and services.

Figure 17 clearly shows that companies' managers consider very positive the ICT solution developed and provided feedback concerning the positive impact in sales due to the visibility of the company on the web.

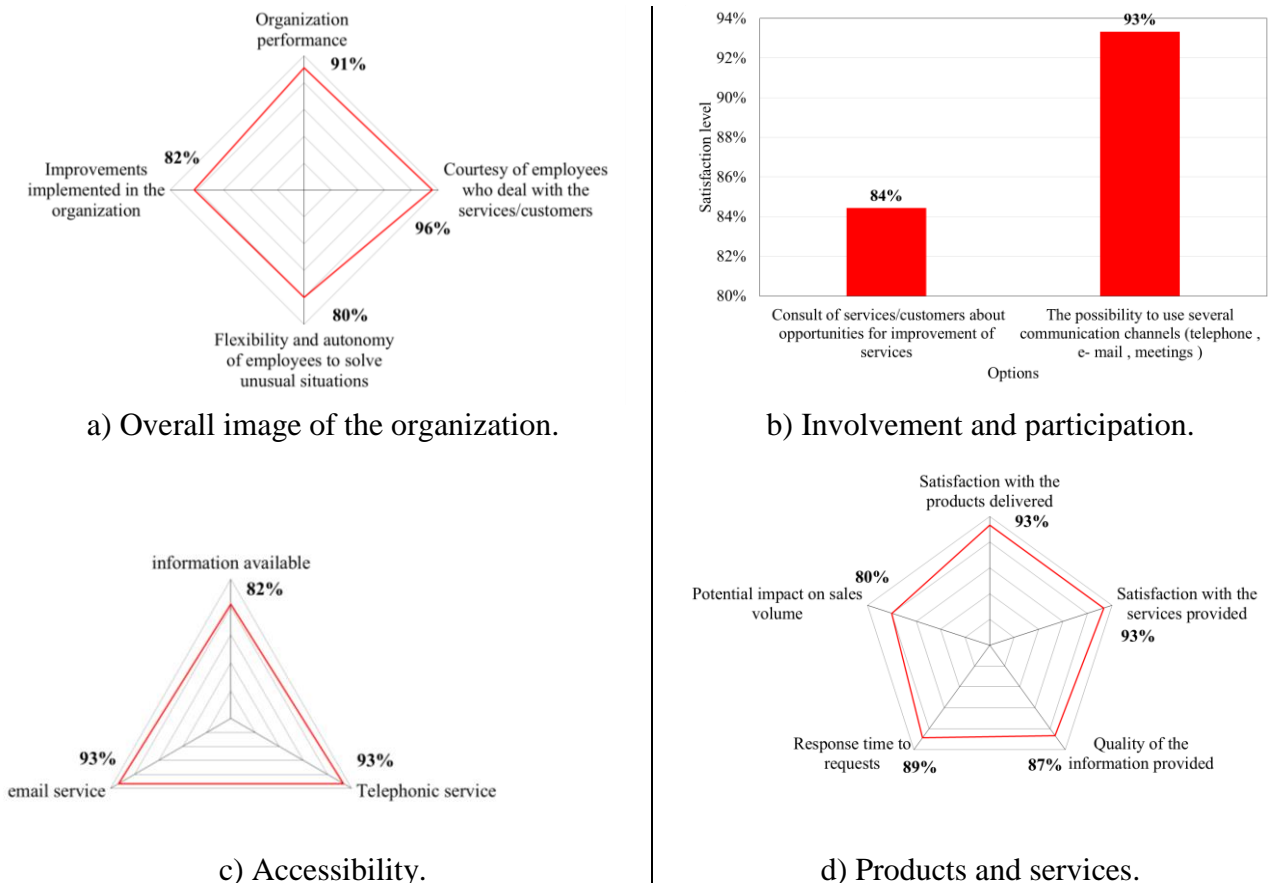


Figure 17. Results of the satisfaction survey results on the ICT solution that was developed.

## 8. CONCLUSIONS

This paper presents the results of a survey for the assessment of the potential for technological modernization and innovation based on ICT. The survey was applied to 50 agri-food companies belonging to Cereals, Cheese, Olive oil, Dry sausages, Honey, Wine, and Horticultural sectors located in the central region of Portugal. The main objective of this analysis is to propose actions and measures that promote economic growth and employment by increasing competitiveness in economy strategic and traditional sectors.

The analysis of results suggests that most company owners and/or managers use ICT tools, but at different levels. There are those that are familiarized in the use of ICT and use it in their enterprise, but also the precise opposite type where they claim total disinterest for ICT, either due to cost or no need for it application in their specific business. Although the study was performed in a limited region of Portugal, what can be seen as limitation by reducing the results generalization, the results are especially useful for countries, like Portugal or Spain, with great opportunities to improve ICT diffusion rates.

From the results analysis, it is recommended to promote ICT training among company collaborators to improve the knowledge on ICT applications as well as their skills. These educational programs aim not only to improve these competences but also to change distrust and suspicion attitudes about ICT tools. The

creation of webpages is also fundamental to promote the visibility of the company and to increase the e-commerce.

The recommendations and suggestions that result from the assessment were applied to a limited set of companies to evaluate and measure the influence of ICT in the competitiveness and economic growth of agri-food traditional sectors. The main ICT solution were the creation of Facebook page and company webpage. A CRM system was developed for one company. A satisfaction survey was carried out at the end of the implementation of the ICT solutions. Companies' managers were fully satisfied with the ICT solution developed specifically for their companies and asserted that the company sales increased due to the web visibility gained by the company products.

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## REFERENCES

- [1] Eurostar, 2015. Households - level of internet access. Statistical Office of the European Communities (Eurostat). Luxembourg. [Accessed: 04/04/2016]
- [2] Eurostar, 2014. Enterprises - level of internet access (NACE Rev. 1.1 activity). Statistical Office of the European Communities (Eurostat). Luxembourg. [Accessed: 04/04/2016]
- [3] Eurostar, 2016. Social media - statistics on the use by enterprises. Statistical Office of the European Communities (Eurostat). Luxembourg. [Accessed: 04/04/2016]
- [4] Eurostar, 2016. Information society statistics - households and individuals Statistical Office of the European Communities (Eurostat). Luxembourg. [Accessed: 22/04/2016]
- [5] EC, 2015. Cyber Security Report - Special eurobarometer 423. European Commission (EC), Directorate-General for Home Affairs.
- [6] Lehmann, R.J., Reiche, R., Schiefer, G. 2012. Future internet and the agri-food sector: State-of-the-art in literature and research. *Comput. Electron. Agric.* 89, 158-174.
- [7] Schiefer, G. 2004. New technologies and their impact on the agri-food sector: an economists view. *Comput. Electron. Agric.* 43, 163-172.
- [8] Kaloxylou, A., Wolfert, J., Verwaart, T., Terol, C.M., Brewster, C., Robbmond, R., Sundmaker, H. 2013. The use of future internet technologies in the agriculture and food sectors: integrating the supply chain. *Procedia Technology* 8, 51-60.
- [9] Mayer, W.H. 2013. Integral ICT solutions supporting farmers businesses as well as environmental caretaking incl. carbon optimization. *Procedia Technology* 8, 550-553.
- [10] Verdegem, P., De Marez, L. 2011. Rethinking determinants of ICT acceptance: Towards an integrated and comprehensive overview. *Technovation* 31, 411-423.
- [11] Bayo-Moriones, A., Lera-López, F. 2007. A firm-level analysis of determinants of ICT adoption in Spain. *Technovation* 27, 352-366.
- [12] Botsiou, M., Dagdilelis, V. 2013. Aspects of incorporation of ICT in the Greek agricultural enterprises: The case of a prefecture. *Procedia Technology* 8, 387-396.
- [13] Sturiale, L., Scuderi, A. 2013. Evaluation of social media actions for the agrifood system. *Procedia Technology* 8, 200-208.
- [14] Moghaddam, B.K., Khatoon-Abadi, A., 2013. Factors affecting ICT adoption among rural users: A case study of ICT Center in Iran. *Telecommunications Policy* 37, 1083-1094.
- [15] Senthilkumar, S., Chander, M., Pandian, A.S.S., Kumar, N.K.S. 2013. Factors associated with utilization of ICT enabled Village Information Centres by the dairy farmers in India: The case of Tamil Nadu. *Comput. Electron. Agric.* 98, 81-84.
- [16] Zhang, Y., Wang, L., Duan, Y. 2016. Agricultural information dissemination using ICTs: A review and analysis of information dissemination models in China. *Information Processing in Agriculture* 3(1), 17-29.
- [17] Ali, J., Kumar, S. 2011. Information and communication technologies (ICTs) and farmers' decision-making across the agricultural supply chain. *International Journal of Information Management* 31, 149-159.

- [18] Ugwoke, B.U. 2013. Promoting Nigerian agriculture through library and information services. *International Journal of Information Management* 33(3), 564–566.
- [19] Nguyen, T., Burgess, S. 2014. A case analysis of ICT for knowledge transfer in small businesses in Vietnam. *International Journal of Information Management* (34)3, 416–421.
- [20] El Kadiri, S., Grabot, B., Thoben, K.-D., Hribernik, K., Emmanouilidis, C., von Cieminski, G., & Kiritsis, D. 2016. Current trends on ICT technologies for enterprise information systems. *Computers in Industry* 79, 14-33.
- [21] InovCluster 2013. MITTIC - Technological Modernisation and Innovation based on ICT in strategic and traditional sectors. Available at: URL: [www.inovcluster.pt](http://www.inovcluster.pt) [Accessed: 11/02/2015].