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FACTORS INFLUENCING CIRCULAR ECONOMY IMPLEMENTATION IN SME BUSINESS MODELS: THE CASE OF SPAIN

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Abstract

Nowadays, Europe has to add more value to the resources it uses and make all sectors more productive. Hence, the transition to a circular economy (CE) requires a stronger link between waste reduction and resource efficiency. Small and medium-sized enterprises (SMEs) are increasingly aware of the benefits of closing loops and improving resource efficiency, creating competitive advantages, and accessing new markets. In the learning of valuing waste as a resource and apply the lessons of the natural world, in which nothing is wasted, SMEs embraces the CE to achieve sustainability. In this regard, the agro-food system plays an important role since it needs agricultural practices aimed at optimising yields and improving the natural resources, which are crucial for embracing CE. We use a mixed methodology, a survey, where 161 SMEs took part, together with six interviews to characterise the sector. The main findings point to the lack of technical and technological resources of olive oil mills, even though they consider innovation crucial to achieve a competitive advantage. Therefore, the European Union (EU) policies, in general, and the Spanish ones, in particular, should reinforce the "Green Economy" and help SMEs incorporate CE principles into their business models.

1. Introduction

In the current global situation of a growing population and an increasing shortage of resources, the European Union (EU) is promoting policies to combat its dubious distinction of being the only region that imports more natural resources and pollution than exports (Tukker et al., 2016). Specifically, the EU is dependent on imports of energy and natural resources, while conversely, other parts of the world are increasing the consumption of resources, which indirectly increases the emissions of other countries (Margarita et al., 2020).

Therefore, Europe has no choice but to add more value to the resources it uses and to make all sectors more efficient in their use. To this end, and in order to meet its long-term emission reduction objectives, the transition of production systems towards the circular economy (CE) is being promoted, which requires a stronger link between waste reduction and efficiency of the resources. We must learn to value waste as a resource and apply the lessons of the natural world, in which nothing is wasted. Along these lines, the current approach of extracting limited raw materials from the earth, using them only once to make a product and then burying them back underground must be replaced by a sustainability-oriented approach.

Thus, during the last decade, there has been a clear trend to promote sustainable production and consumption considering the need to introduce CE principles and practices in the companies' business models (Tseng et al., 2018).

Circular Economy can be considered a pre-requisite for sustainability (Geissdoerfer et al., 2017). Kenneth E. Boulding first proposed the concept of CE in 1966 and, after decades of research and development, the connotation and concept of CE has become commonplace and are applied to the development of families, companies and countries (Wang et al., 2014).

In recent decades, the industry has evolved, but is always framed within the linear economy model governed by the "make-use-throw away" or "take-make-use-destroy" (Ghisellini et al., 2016) principle that has been increased by globalization. This is characterised by homogenization and increased demand, which have ultimately led to a global increase in the use of resources. Therefore, moving towards a CE is not only possible, but also profitable; however, this does not mean that the switch to CE can be made without implementing and adopting appropriate policies.

CE must be accompanied by the design of the business model for the success of the company (Bocken et al., 2016), where small and medium-sized enterprises (SMEs) play a crucial role. According to the World Bank (2020), SMEs represent around 90% of companies and more than 50% of employment worldwide. Formal SMEs contribute up to 40% of national income (GDP) in emerging economies. These figures are significantly higher when informal SMEs are included. Further, statistics show that 600 million

jobs will be needed by 2030 to absorb the growing global workforce, making SME development a high priority for many governments worldwide (World Bank, 2020).

SMEs operate and create opportunities in a wide range of geographic areas and sectors; and some SMEs are driven by social impact and triple bottom line goals, where CE can be found. However, it is known that SMEs do not usually link well with the concept of CE (Rosa et al., 2020). In this line, agricultural SMEs play an important role, since they need practices that allow them to optimise yields and at the same time improve natural resources such as soil, water and air quality, a crucial aspect for the adoption of the CE.

These practices are designed to last in the long term, ensuring long-lasting performance (Kristensen et al., 2016). The goal of an established performance could be achieved through innovation, technical and technological resources, which play an intertwined role in SMEs in the agrifood sector. The pressure towards sustainability from the external environment drives innovation by SMEs to maintain or improve their performance.

Innovation in the food sector is of special interest, since this industry could exploit the synergies generated thanks to the relationships between agro-industrial production and innovations in product and process design. However, few studies analyse the relationships between the drivers of the transition towards sustainability and the CE of companies in the olive oil sector (Siciliano et al., 2016: Barón et al., 2020).

Consequently, this paper proposes to increase understanding of the role of CE in the development of SMEs models, paying special attention to the technological resources of SMEs.

The factors selected to study the level of implementation of the CE and the barriers in the business models developed by SMEs are the following: the company's R&D expenditure in five years (2013-2018), the endowment of production technologies and product innovation or the application of its know-how. Literature commonly applies these factors. Therefore, this study tries to answer the following research questions:

- R.Q. 1 How does R&D investment affect the transition of SMEs towards the CE?
- R.Q. 2 Could the provision of production technologies and product innovation influence the implementation of CE by SMEs?
- R.Q. 3 From the point of view of ownership and management, what variation is there in the behaviour of family companies, compared to non-family companies in the implementation of the CE?

To achieve the objective of our study, we carried out an electronic survey of a sample of 1,266 Spanish olive oil companies, with a response rate of 12.72%. From these companies, we selected the market leaders for six in-depth interviews.

The remainder of this paper is organised as follows. Section 2 reviews the literature about the concept and key insights of CE principles related to SMEs. Section 3 presents the methodology for characterising the technological resources of Spanish Olive Oil Mills, combining quantitative and qualitative methodological tools. Section 4 presents the main findings of this research. Finally, Section 5 presents the conclusions, a brief discussion about the topic, the main limitations of the paper, and suggests some future research lines.

2. Literature Review

Before the introduction of CE, the only process followed during product conceptualisation, design, development, use, and disposal was traditional/linear. However, these closed-loop standards focused entirely on balancing economic, environmental and social impacts, have replaced old industrial practices and, therefore, strategies (Rosa et al., 2020). For this reason, different schools of thought have mentioned CE, we consider it a section of sustainability science, rooted mainly in industrial ecology (Erkman, 1997) and cleaner production research currents (Ünal et al., 2019) shaping an innovative industrial model, what could help SMEs to be successful and help future generations to improve their well-being.

2.1 Circular economy approach

CE is an industrial economic model that is restorative and regenerative by intention and design (Ellen MacArthur Foundation, 2013; Lieder & Rashid, 2016; Haas et al., 2015), such that the production system regenerates the inputs used and tries to reduce its negative externalities (Núñez-Cacho et al., 2018). Its objective is to efficiently manage resources, minimize waste with renewable energy and reduce the quantum of chemical pollutants and toxic waste through careful design of the entire process.

An efficient CE in the use of resources can be achieved only with the participation of all bodies and entities, state and non-state. The industrial sector plays a crucial role as an engine of technological development and innovation involving better and more careful use of natural resources. All these in turn improves the competitiveness of SMEs (Jabbour et al., 2019).

The CE received promotion and encouragement from global corporations, the Ellen MacArthur Foundation, NGOs, academics and researchers from the EU. However, SMEs have always found implementation very difficult due to their lack of several components that larger companies have, such as capital and technical and/or technological know-how. The CE presents diverse antecedents. The first is the theory of Industrial Ecology,

developed by authors such as Frosch and Gallopoulos (1989) or Allenby (1998). The latter points to the need to develop technologies and strategies to work comprehensively with complicated natural systems coupled to different scales.

Second, the field of industrial symbiosis also acts as a precursor to CE, where Chertow (2007) highlighted the conscious effort to identify companies from different industries and locate them together, so that they can share resources, laying the foundation for the emergence of eco-industrial parks.

A third origin is found in biomimicry innovation inspired by nature, by respectful imitation (Benyus, 2002). This author considers that, unlike the Industrial Revolution, the Biomimetic Revolution introduces an era based not only on what we can extract from nature, but also on what we can learn from it.

The fourth origin is that the cradle to cradle reformulates design as a positive regenerative force that seeks to create footprints to delight in. This paradigm shift reveals opportunities to improve quality, increase value, and stimulate innovation (McDonough & Braungart, 2002). This school of thought is closely related to the pursuit of the objectives of the Triple Bottom Line and the promotion of awareness in companies of the environmental and social impacts of their activities.

This awareness drives them to minimize their ecological footprint. That quest begins with the recognition of the deep-seated business value of natural and social capital and fosters the achievement of potential synergies among economic, environmental, and social business goals (Braungartet al., 2007). Further, the field of eco-efficiency (Schaltegger & Sturm, 1989; Schmidheiny, 1992) can be seen as an indicator of environmental performance or as a business strategy for sustainable development (Koskela & Vehmas, 2012). Finally, we must mention the CE that considers waste as food, that is, inputs for a new process (Andersen, 2007).

Unlike the traditional extensive form of economic development of "high input, high consumption, high pollution and low efficiency", the principle that governs a CE is "reduce, reuse, recycle", which consists of the characteristics of low consumption, low emission and high efficiency. Therefore, the system can reduce pressure on resources and the environment, preserve natural resources, reduce environmental pollution, and prevent the destruction of environmental resources and systems. (Wang et al., 2014).

According to Rizos et al. (2016), the transition to the CE in the sectors of mobility, food and the built environment could reduce emissions by 48% by 2030 and 83% by 2050, vis-a-vis to 2012 levels. Further, the CE concept has been an essential component of the resource efficiency initiative of the EU2020 strategy (Skene, 2018). This author highlights how the adoption of circular business models is related to significant employment potential, particularly in the recycling and re-manufacturing industries, basic metals and metallic products, and the electronics and household appliances in-

dustry, inter alia. More than 50,000 jobs could be created in each sector per country. Additionally, in terms of environmental benefits, becoming more circular would help avoid emissions, reduce resource loss, and ease the burden on global ecosystems. Resource and environmental problems have also been major limiting factors for sustainable development.

However, the development of the CE can be carried out from different spatial dimensions such as the business level, regional level, city level and national level. The business level plays a relevant role in the development of CE that will directly affect the regional and national levels of CE development (Wang et al., 2014). These dimensions have been summarised in three levels. The micro-level includes products, companies and consumers; the meso-level is related to eco-industrial parks and the macro-level refers to the city, region, nation and supranational spheres (Núñez-Cacho et al., 2020).

This change is required towards a new "circular" paradigm based on "Reduce, Reuse and Recycle" resources. Companies have implemented various practices within the CE, such as prioritising regenerative resources, converting and disposing of waste, designing durable and re-assemblable products, combining products and services in "pay-per-use or product-service (PSS) systems" that could, in turn, generate opportunities and income streams (Ghisetti & Montresor, 2020; Ünal et al., 2019).

2.2 Resource-based View (RBV)

The Resource-based vision (RBV) is an intersectoral approach applied to the study of business strategy. It is based on the idea that the possession and management of certain resources can generate a competitive advantage for the company (Penrose, 1959). This advantage could become durable in the long term when its resources are valuable, rare, inimitable and irreplaceable for companies (Barney, 1991). Most of these advantages are related to the company's intangible resource endowment, which, according to the RBV, can become the source of its strategic advantage. RBV helps the changes of a business model based on CE, since building and complementing the portfolio of resources of a company provides a sustainable advantage (Lahti et al., 2018).

Several authors, such as Grant (1991) and Bueno (2003; 2011), classify intangible resources as technological, human, relational and organizational. Thus, the issue of sustainability and its relationship with R&D has received less attention. Regular evaluation of technological advances could give SMEs a sustainable competitive advantage.

Ecological issues have had a direct effect on R&D, concerning product innovation (Foster & Green, 2000). Along these lines, the new concept of eco-innovation connects technological development with environmental aspects (Smol et al., 2017). Further, Dangelico and Pujari (2010) pointed to

green product innovation as one of the crucial factors to achieve growth, environmental sustainability and a better quality of life.

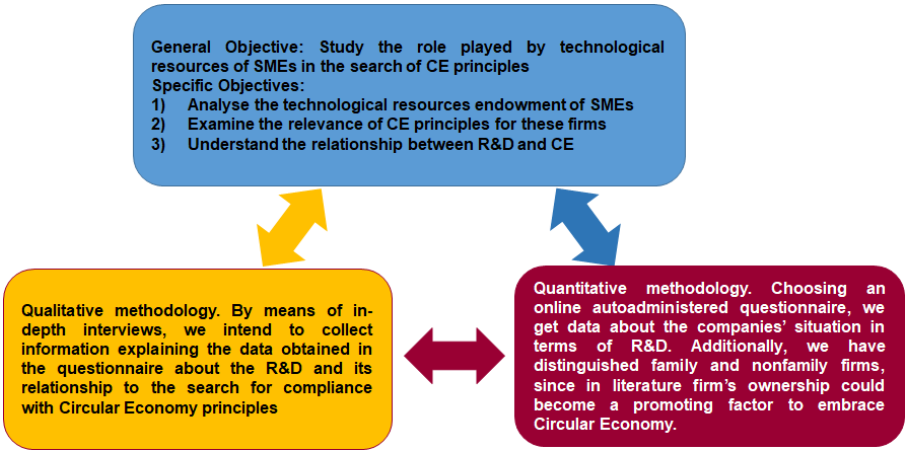
However, the literature indicates the lack of technical and technological knowledge as one of the main factors hindering the transition of SMEs from linear to circular business models. In fact, linear technologies are widely implemented by businesses, keeping the economy locked in its current form. Therefore, this transformation and change of day-to-day operations would require that new technologies for sustainable production and consumption (in the fields of eco-design, clean production and life cycle assessment) be integrated into current linear business models. Additionally, human capital must be transformed in parallel to catch up with the new models of management, creating new job opportunities. However, consumers have not yet changed their mind about what does not attract the demand for environmentally friendly technologies. Together with inadequate technical, capacities play a crucial role in the underdevelopment of the CE.

Lack of technical know-how can lead SMEs to adopt linear technologies and familiar business models, based on their suppliers' suggestions for innovative technical solutions. Rizos et al. (2015) point out how for SMEs to successfully implement CE, it is necessary to know the challenges they face, especially the problem of lack of resources. Lieder and Rashid (2016) emphasise that the development of business models is essential for that implementation. Agyemang et al. (2018) indicate that the availability of financial resources, lack of experience, insufficient technical and technological capacity pose obstacles to SMEs' transition to the CE (Binek & Al-Muhannadi, 2020).

3. Methodology

In this work, we applied a qualitative-quantitative triangulation (see Figure 1). This combined research strategy requires the application of tools from both research traditions, qualitative and quantitative, in searching the determinants of CE implementation by SMEs.

Fig. 1 - Methodological triangulation.



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3.1 Design of the sample

This study investigates a sample of 1,266 of Spanish olive oil mills, both registered in Denominations of Origin, and those not covered by any Denomination. Among the companies selected, 36% are registered with twenty-two Regulatory Councils of Denominations of Origin.

3.2 Methods

The study has a descriptive scope, using both a quantitative and qualitative analysis.

Regarding the quantitative analysis, it uses the widely accepted methodology of Churchill and Surprenant (1982) for the construction of measurement scales that made up the questionnaire.

This questionnaire was validated through a pre-test sent together with a cover letter to the Spanish oil mills included in the sample. Additionally, an individualized link was attached, highlighting the objectives of the research, its interest and importance, seeking to involve the largest number of oil mills in the study.

After the pre-test and the adjustments derived from it, the self-administered electronic survey was finally sent to a population of 1,266 Spanish olive oil mills, reflecting the main interests of the project: the nature of the mill and its resources and technological capabilities.

The companies completed 161 questionnaires in total, resulting in a response rate of 12.72%. The data received were analysed using the SPSS

software to check the reliability and validity of the scales, using Cronbach's Alpha, resulting in all the values obtained being above 0.7.

The analysis used qualitative methodology too. Thus, once the quantitative information was analysed and for a better understanding of the results, we deepened the implementation of the CE by the companies that made up the sample. For this, six case studies were selected, and the corresponding in-depth interviews carried out between 2018 and 2020. The companies to be interviewed were selected for their leadership position in the sector. The main data collection method involved semi-structured interviews with six informants, as this is a common and powerful way of understanding other human beings (Glover & Reay, 2015). Initially and before the date, time and place of each interview, we obtained preliminary information and additional sources for triangulation (Miles & Huberman, 1994). These sources are their websites, articles published in the press, observations, informal discussions, business websites, company brochures, informal telephone follow-ups, industry publications and information provided by various business databases, including the Sistemas de Análisis de Balances Ibéricos (SABI).

Before conducting the interviews, an open, flexible questionnaire was prepared according to the requirements of each. The order of the questions was illustrative, facilitating the passage through certain aspects not previously considered or even in those to which the informant paid special attention.

4. Findings

Technological progress helps to improve production processes, making the business sustainable. In this regard, the factors selected to identify and evaluate the technological resources of a company refer to its the degree of research, development and technological innovation (R&D), technological endowment, intellectual and industrial property and the results of the innovation.

The technological resources of the selected Spanish oil mills refer to the following aspects, frequently used in the literature: the company's R&D expenditure, the provision of production technologies, product innovation and the application of its know-how.

In particular, we have analysed the spending of the SME on R&D as a percentage of its total sales, in a period of five years (2013-2018).

Subsequently, the production technologies of SMEs were compared with the rest of the companies in the sector, the development of new products and the improvements they make in their production activities and the application of their know-how.

First, our results show that 66.5% of Spanish oil mills do not allocate resources to R&D (see Figure 2), considering the percentage of R&D ex-

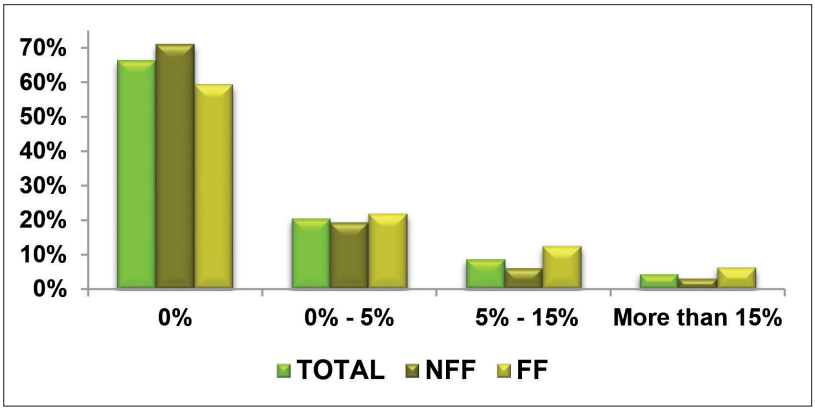
penditure by olive oil companies during 2013-2018 in relation to their total sales. Thus, almost 90% of Spanish oil mills allocate less than 5% of their sales for R&D and only four out of every hundred companies spend 15% or more of their sales on R&D expenses.

Additionally, since ownership is included in corporate governance and plays a crucial role related to property rights, characteristics and interrelationships (Wang et al. 2014), we consider this variable one of the main that could determine the differences when deciding to go from linear model to CE model. Due to the basic ownership position in the corporate governance structure, we have included this distinction when describing our results on this part of technology resources.

Additionally, when ownership and management overlap, incentives to protect their investment and monitor managers have also increased (Wang et al., 2014). Therefore, we analysed whether there were differences in SMEs based on their family nature. In this regard, the results on R&D indicate that when family and non-family oil mills are compared, 6.3% of the former allocate more than fifteen percent of their total sales to R&D expenses, while in the second group this percentage is lower at 3.1%.

This lower investment in R&D by non-family businesses is also found in the fact that 70% of them do not intend to invest in R&D, while family companies in the same situation do not exceed 60%.

Fig. 2. - R&D Expenditure vis a vis total sales (2013-2018).



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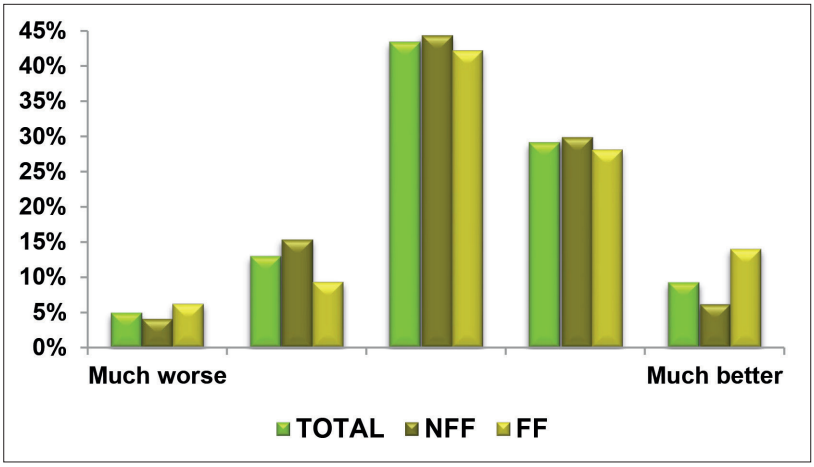
The second factor analysed is the production technology of the Spanish oil mills included in the sample. Specifically, from the results, it is observed that 38.5% of the companies consider their production technology to be better or much better than that of their main competitors. Only eighteen companies out of hundred have considered it lower (see Figure 3).

When evaluating the technological resources of companies in the sector, we can find no differences of businesses' perceptions depending on their family nature. 14.1% of family businesses believe that they have a much better position in their production technologies compared to non-family businesses (only 6.2%).

Fig. 3 - Production Technology.



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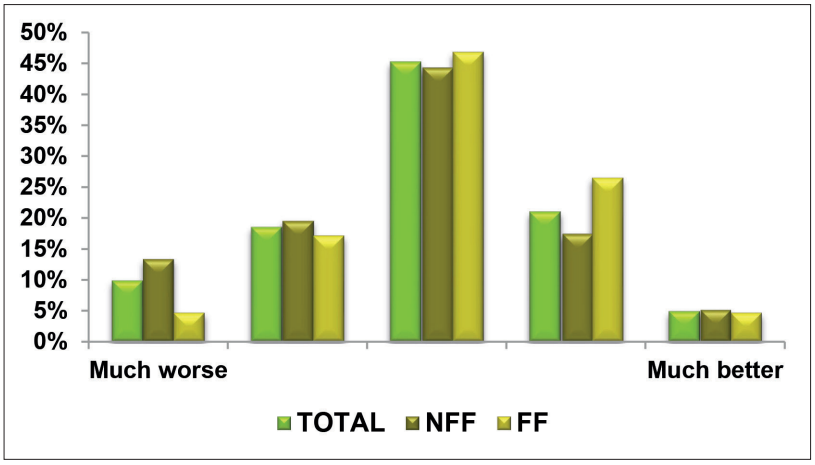
Further, the development of new products is also one of the variables used to examine the intangible resources of companies. In the Spanish olive oil sector, our results show that the level of new product development of 28.5% of companies is lower than that of their main competitors, that is, respondents consider it worse or much worse (see Figure 4) than their competitors. A higher figure of 31% family olive oil mills considered themselves better or much better positioned in this aspect than their main competitors, while non-family companies that declared this perception were almost 22%.

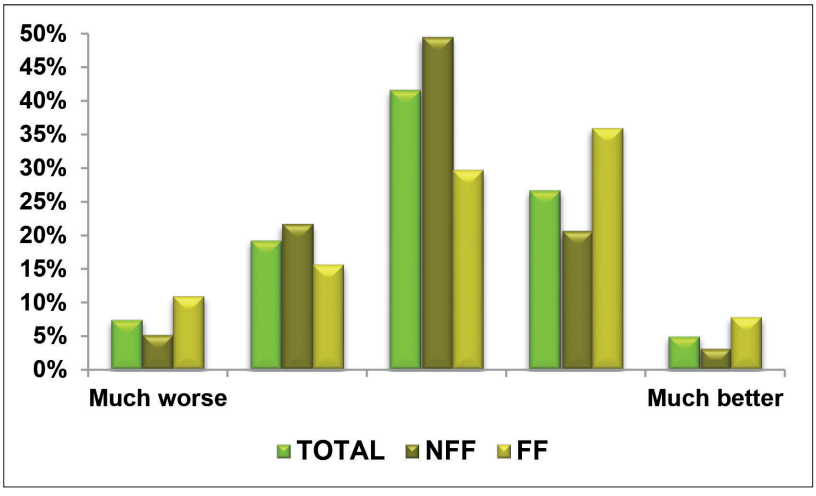
Fig. 4 - Development of new products.



Source: own elaboration

Finally, compared to their main competitors, 31.7% of the Spanish oil mills are considered superior concerning the improvements they make in their production activities and in the application of their know-how. In this sense, there are also significant differences between the results obtained and reflected in Figure 5, examining the family or non-family nature of the olive oil mills.

Fig. 5 - Improvements in production activities and know-how application.



Source: own elaboration

Thus, while almost 40% of family businesses claim to have developed better or much better productive activities and application of know-how than their competitors, this percentage does not reach 24% when non-family businesses are considered.

One of the explanations given by the respondents about this capacity improvement is: *"The most demanding markets are requesting products adapted to a changing lifestyle and, at the same time, are increasingly concerned about health, well-being and the environment. Our priority is to ensure the highest quality standards. For this reason, 20% of our profits go to our internationalization department"*. (E4-1).

This argument underscores how international customers and suppliers could push the company to adopt CE principles, supporting the interest in analysing the role that supply shift examination plays in CE adoption (Dubey, 2019).

A diametrically opposite point of view comes from some firms that believe it unnecessary to launch new products or seek new uses. They highlight new commercial strategies as crucial to obtain a source of competitive advantage: *"Well, it is not that olive oil has new uses, it had them in ancient times. We have not discovered anything new, but we are looking for new strategies to launch and we introduce products, but olive oil, formerly lampante olive oil, acquires the name from the lamp and balm that is given to gladiators. So, it is nothing new, so it is nothing new, but now it is more sophisticated for cosmetics and for all kinds of soaps, gels, creams... Now, you have been giving all the uses that the product has, which were not given before. In all products, it is about looking at different lines of business. The mentality changes and you stop doing some things because you do others. So, well, it seems to me that everything you should try to add value to the product ... is what you have to do"*. (E3-1).

A significant increase in R&D investment is necessary, since most of the SMEs analysed acknowledge that their investment is lower than that of their direct competitors. R&D not only applies to the processes of obtaining olive oils, but also to the management of companies and crops to make them more productive and thus fight against the rise in production costs that the sector has been experiencing. The proposals can be espalier or super-intensive; however, they are not compatible with most olive oil landers.

One of the interviewees highlighted how innovation is needed in all the links of the value chain to achieve a competitive advantage: "*Because [the sector] operates in a context that does not support anything, I believe innovation is the basis that this [business model] begins to awaken and companies can achieve an advantage of differentiation*". (E2-1).

New producers with significant future power such as Australia, South Africa, Argentina, Chile and China seem to invest in R&D mandatory if companies want to continue being spearhead in the sector. To compete with the new international players, many companies are aware of the relevance

of R&D for their success. For this reason, one of the respondents points out: "*And for us the future revolves around two key elements: one is innovation and the other is research. Innovation… it is difficult to innovate a product where it has 5,000 years of history and even because a boat has recently been discovered in the area of Syria, which seems to be the oldest in the Turkey area… but in the Middle East that has about 8,000 years of history, a pot of oil, that is, supporting my idea. Well, it is possible to innovate and it is necessary to innovate. When we speak of innovation… we speak of innovation in all fields of our activity… innovation in the agronomic part. Fortunately, we are harvesters, fortunately, we can act and interact in the agronomic part, in the trees, on how to prune, how to water, how to fertilize, how to treat the vegetation cover, how to enrich the habitat, how to enrich, say, the zoo component, etc. There is a beastly field of innovation. We know very little about the agronomic part; to innovate on the industrial side… I think that, right now, industrial farmers, collectors, we are facing challenges that our parents were completely unaware of, even those who never had it, one thing called early harvest added with another exogenous factor that is climate change*". (E1-1).

In this line, eco-friendly products should have quality embedded, in fact another respondent pointed out that: "*We try to make the customer fall in love with our olive oil, because of… the concept of quality… the issue of pesticide-free, because it is a very important issue in the agricultural enterprise agro-community policy is going that way. You are producing respect for the environment or you're going to be ruined [out of the market]. Unless you're looking at it, rural areas are depopulated because people are leaving the countryside, now it's coming back because of the healthy and socioeconomic crisis due to COVID-19"*. (E6-1).

Additionally, several authors highlighted that Industry 4.0 tools could drive the deployment of a new generation of CE initiatives (Tseng et al., 2018), as well as the mutually beneficial relationship that exists between Industry 4.0 and the CE (Lopes de Sousa et al., 2018).

These authors also pinpoint the contribution of the industry 4.0 to sustainable operations management decisions and new business models by means of integrating value chains through data collection and sharing.

Moreover, Rajput and Singh (2019) identified Artificial Intelligence, Service and Policy Framework as significant enablers connecting CE and Industry 4.0.

Thus, new technologies that make up Industry 4.0 should be considered, whose paradigm is closely related to the CE: big data and analytics, autonomous robots and vehicles, additive manufacturing, simulation, augmented and virtual reality, horizontal/vertical system integration, the Internet of Things (IoT), cloud, and edge technologies, and blockchain and cyber-security (Rüßmann et al. 2015). Data-driven analysis can potentially be used to optimize the sustainable solutions intended to reduce the resource and emission intensities of industrial systems (Tseng et al., 2018).

Therefore, sustainable operations management decisions contribute to implementing the connection between the principles of CE and Industry 4.0 approaches (Lopes de Sousa et al., 2018).

Some of these technologies are cheap and accessible. This could enable SMEs with a set of important improvements in competitiveness when these new technologies are applied to production (Zhou et al., 2015), market growth (Sanders et al., 2016), supply chain and product lifecycle (Porter & Heppelmann, 2014), to enable workforce (Oesterreich & Teuteberg, 2016), and to implement business models (Lee et al., 2014).

Companies are conscious of the competitive advantage to be attained by acquiring technical and technological knowledge: *"At the technological level, we have enormous challenges. Why? Because every day we are learning more about oils, that is, 20 years ago nothing was known about biophenols, no one understood what europein was, no one knew what oleocantal was, drexityroxol and tyroxol were only known to scientists. These challenges call for us. Then we realize that Virgin Extra Olive Oil (VEOO) is not only a seasoning or foods that are enormously rewarding from a sensory point of view; there is an important hedonistic pleasure in consuming it because it is a gourmet food, a food that fills us."*. (E1-1).

The CE is very relevant in the Olive Oil sector due to its being land-rooted, and its strong attachment to the territory, up to the point that some firms help to change environmental mindset of their community. One interviewee highlighted how they teach their community to recycle, for example: "*The relationships that are maintained [with its community] are good, because they know that here they have their home for what they need, when they want knowledge, do recycling, learn to track the product down... there we are*". (E3-1).

However, our SMEs sample complaints about the lack of financial support by government bodies to R&D investment: "*And it's a mistake, the real innovation, for example, here in E [autonomous community to which the olive oil mill belongs], and [innovation] in oils comes from the industrial sector, where we are spending money, each one [invest] depending on their possibilities.*". (E5-1).

Therefore, the inclusion of the CE in business models should be analysed as one of the main challenges of SMEs to develop a long-term lasting competitive advantage: "*What's behind that H [element associated with the company and brand] ...? It is rigor, product quality, quality in its human resources, quality in its management, sustainability, corporate social responsibility, involvement with the environment, correct and cordial relations with the governmental bodies, good corporate governance*". (E1-1).

5. Discussion, Conclusions, Implications, Future Research Lines and Limitation

The paradigm shift that the transition to the CE implies is a need that SMEs have to transform into reality. A new way of managing and producing emphasizes the efficient organization of limited resources, the pursuit of reducing environmental impact and the abandonment of a model that generates waste and emissions and consumes resources.

CE, together with industrial symbiosis, share a restorative system approach. Its objective is to repair the previous environmental damage by designing better production systems. At this point, companies should be able to include CE principles in their business models to achieve a better balance and harmony between the economy, the environment and society (Ghisellini et al., 2016).

Spanish olive oil SMEs must increase their investment in R&D to overcome their lack of technical and technological knowledge to efficiently manage resources, minimize waste by using renewable energy and reduce the number of chemical pollutants and waste toxic through careful design. This will translate into a reduction in their CO2 footprint and a better use of their resources.

Although these companies are perceived better or much better in almost all the indicators analyzed, the truth is that they are not technology-based companies and they do not allocate sufficient funds to R&D activities. Specifically, the majority invest less than 5% of total sales in R&D. These figures should be reversed if they want to maintain the leadership position they have occupied in recent years. The current health crisis has revealed their weaknesses in terms of technological resources and application of know-how. This lack of capabilities is evident even when they are related to the implementation of the CE principles.

On the other hand, we find that firms more attached to and rooted in their territory are also more committed to the circular economy, sustainability and the creation of a restorative production system. Along these lines, future research should delve into the role of family businesses, that are intertwined with their community. Ownership and management of the business in family or non-family hands could determine the fastest adoption of the circular economy. Thus, the study of the different levels of implantation of CE between family and non-family businesses, due to their link with the community, constitutes another line of future research.

From this research, we can state several practical implications. In the near horizon, SMEs must transition towards more sustainable models than the current ones, with the CE being an instrument for implementing this process. The transition will result in a lower carbon footprint and a resource-conscious production system.

The Spanish olive oil SMEs need greater investments that allow them to develop the new production models. The lack of financial resources poses an important barrier for Spanish SMEs when undertaking these processes of change. This work has shown how the lack of capital represents one of the most prominent barriers to the introduction of innovation and adoption of CE by SMEs (Rizos et al., 2015). This change from a linear production / business model to a circular one requires substantial time and investment on the company's part (Lahti et al., 2018).

This financial barrier goes hand in hand with the need for high levels of time and human investments, which are usually very relevant for SMEs (Rizos et al., 2016). Green business elements represent an additional monetary investment, to which SMEs are more sensitive than large companies, which is why SMEs often look for technology already available on the market (European Bank for Reconstruction and Development, 2020; Grant et al., 2014; Rizos et al., 2016).

Therefore, SMEs could take advantage of Industry 4.0 which is based on nine pillars (big data, autonomous robots, simulation, additive manufacturing, IoT, cloud computing, augmented reality, horizontal and vertical integration and cybersecurity), some of them accessible and inexpensive, enough not to become a technological barrier. These are implications for future work on Industry 4.0 and future business models for SMEs.

Finally, this work presents its limitations. The main limitation of our study is the use of only one kind of resource to approach the study. Future lines should include other resources in addition to technological ones. Further, future research should examine what type of technology has been included in the technological resources. Further, we do not know to what extent our findings will apply beyond the Spanish olive oil industry, which constitutes another avenue of future research.

References

Allenby, B. (1998). Earth Systems Engineering: The Role of Industrial Ecology in an Engineered World. *Journal of Industrial Ecology, 2*(3), 73-93.

Andersen, M. S. (2007). An introductory note on the environmental economics of the circular economy. *Sustainability Science, 2*(1), 133-140.

Benyus, J. M. (2002). *Biomimicry. Innovation inspired by nature*. New York: Harper Perennial. Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management, 17*(1), 99-120.

Barón, A.; de Castro, R.; Giménez, G. Circular Economy Practices among Industrial EMAS-Registered SMEs in Spain. *Sustainability* 2020, 12, 9011.

Binek, Doğuş and Al-Muhannadi, Khawla (2020) Small and Medium-Sized Enterprises within the Circular Economy: Challenges and Opportunities. *Hungarian Agricultural Engineering* (37). pp.5-13.

Bocken, N., de Pauw, I., Bakker, C. & van der Grinten, B. (2016). Product design and business model strategies for a circular economy. *Journal of Industrial and Production Engineering*, *33*(5), 308-20.

Braungart, M., McDonough, W., & Bollinger, A. (2007). Cradle-to-cradle design: healthy emisions – a strategy for eco-effective product and system design. *Journal of Cleaner Production, 15*, 1337-1348.

Bueno, E. (Coord.) (2003). *Model for the measurement and management of intellectual capital: Intellectus Model, Intellectus Documents* (5), Centro de Investigación de la Sociedad del Conocimiento (CIC), CIC-IADE (UAM), Madrid.

Bueno, E. (Coord.) (2011). *Model for the measurement and management of the intelectual capital: Intellectus Model, Intellectus Documents* (9/10), Centro de Investigación de la Sociedad del Conocimiento (CIC), CIC-IADE (UAM), Madrid.

Chertow, M.R. (2007). "Uncovering" industrial symbiosis. *Journal of Industrial Ecology,11*, 11–30.

Churchill, G., & Surprenant, C. (1982). An investigation to the determinants of customers satisfaction. *Journal of Marketing Research, 19*(4), 491-504.

Dangelico, R.M., & Pujari, D. (2010). Mainstreaming green product innovation: why and how companies integrate environmental sustainability. *Journal of Business Ethics, 95(3),* 471 – 486.

Dubey, R., Gunasekaran, A., Childe, S. J., Papadopoulos, T., & Helo, P. (2019). Supplier relationship management for circular economy. *Management Decision, 57*(4), 767-790.

Ellen MacArthur Foundation (2013). Towards the Circular Economy, https://www.ellenmacarthurfoundation.org/assets/downloads/publications/Ellen-MacArthur-Foundation-Towards-the-Circular-Economy-vol.1.pdf (Last access 29 July 2020).

Erkman, S., (1997). Industrial ecology: An historical view. *Journal of Cleaner Production, 5*(1–2), 1–10.

European Bank for Reconstruction & Development (2020). https://www.ebrd.com/what-we-do/sectors-and-topics/ebrd-small-business-initiative.html. Last access 29 July 2020.

Foster, C., & Green, K. (2000). Greening the innovation process. *Business Strategy and the Environment*, *9*(5), 287 – 303.

Frosch, D, & Gallopoulos, N. (1989). Strategies for manufacturing. *Scientific American, 261*(3), 94–102.

Geissdoerfer, M., Savaget, P., Bocken, N. M. P, & Hultink, E. J. (2017). The Circular Economy - A new sustainability paradigm? *Journal of Cleaner Production*, 143, 757-768.

Ghisellini, P., Cialani, C., & Ulgiati, S. (2016). A review on circular economy: the expected transition to a balanced interplay of environmental and economic systems. *Journal of Cleaner Production, 114*: 11-32.

Ghisetti, C., & Montresor, S. (2020). On the adoption of circular economy practices by small and medium-size enterprises (SMEs): does "financing-as-usual" still matter? *Journal of Evolutionary Economics*, *30*(2), 559-586.

Glover, J. L., & Reay, T. (2015). Sustaining the Family Business with Minimal Financial Rewards: How Do Family Farms Continue? *Family Business Review*, 28(2), 163-177.

Grant, K., Edgar, D., Sukumar, A. and Meyer, M., (2014). Risky business': perceptions of e-business risk by UK small and medium sized enterprises (SMEs). *International Journal of Information Management, 34*(2); 99-122.

Grant, R. M. (1991). The resource-based theory of competitive advantage: Implications for strategy formulation. *California Management Review, 33*(3): 114-135.

Haas, W., Krausmann, F., Wiedenhofer, F., & Heinz, M. (2015). How Circular is the Global Economy? An Assessment of Material Flows, Waste Production, and Recycling in the European Union and the World in 2005. *Journal of Industrial Ecology, 19*(5), 765-777.

Jabbour, Ch., Jabbour, J., Lopes de Sousa, A.B., Sarkis, J. & Filho, M. G. (2019). Unlocking the circular economy through new business models based on large-scale data: An integrative framework and research agenda, *Technological Forecasting and Social Change*, Elsevier, 144(C): 546-552.

Koskela, M, & Vehmas J, (2012) Defining eco-efficiency: a case study on the Finnish forest industry. *Business Strategy Environment, 21*(8):546–566.

Kristensen, D. K., Kjeldsen, C., & Thorsøe, M. H. (2016). Enabling sustainable agro-food futures: Exploring fault lines and synergies between the integrated territorial paradigm, rural eco-economy and circular economy. *Journal of Agricultural and Environmental Ethics, 29* (5), 749-765.

Lahti, T., Wincent, J., & Parida, V., (2018). A Definition and Theoretical Review of the Circular Economy, Value Creation, and Sustainable Business Models: Where Are We Now and Where Should Research Move in the Future? *Sustainability*, *10*, 2799-2798.

Lee, J., Kao, H.A., & Yang, S. (2014). Service innovation and smart analytics for industry 4.0 and big data environment. *Procedia CIRP, 16.*

Lieder, M. & Rashid, A., 2016. Towards circular economy implementation: A comprehensive review in context of manufacturing industry. *Journal of Cleaner Production, 115*, 36–51.

Lopes de Sousa Jabbour, A.B., Jabbour, C.H., Filho, M.G. & Roubaud, D. (2018). Industry 4.0 and the circular economy: a proposed research agenda and original roadmap for sustainable operations. *Annals of Operations Research, 270*(1), 273-286.

Manninen, K., Koskela, S., Antikainen, R., Bocken, N., Dahlbo, H. & Aminoff, A. (2018). Do circular economy business models capture intended environmental value propositions? *Journal of Cleaner Production, 171,* 413-422.

Margarita, R., Villar José, & Pereira, E. T. (2020). The determinants for a circular economy in Europe. *Environmental Science and Pollution Research International*, *27*(11).

McDonough, W., & Braungart, M. (2002). *Cradle to cradle: Remaking the way we make things*. New York, NY: North Point Press.

Núñez-Cacho, P., Molina-Moreno, V., Corpas-Iglesias, F.A., & Cortés-García, F.J. (2018). Family Businesses Transitioning to a Circular Economy Model: The Case of "Mercadona". *Sustainability, 10*, 538-556.

Núñez-Cacho, P.; Leyva -Díaz, J.C.; Sánchez-Molina, J.; Van Der-Gun, R. (2020). Plastics and sustainable purchase decisions in a circular economy: The case of Dutch food industry. *PLoS One*. 2020, 13. 9.

Oesterreich, T. D., & Teuteberg, F. (2016). Understanding the implications of digitisation and automation in the context of Industry 4.0: A triangulation approach and elements of a research agenda for the construction industry. *Computers in Industry, 83*, 121-139.

Park, J., Sarkis, J. & Wu, Z., (2010). Creating integrated business and environmental value within the context of China's circular economy and ecological modernization. *Journal of Cleaner Production, 18*(15), 1492–1499.

Penrose, E. T. (1959). *The theory of the growth of the firm*. New York: John Wiley & Sons.

Porter, M. & Heppelmann, J. (2014). How smart, connected products are transforming competition. *Harvard Business Review, 92*(11), 64-88.

Rajput, S., & Singh, S. P. (2019). Connecting circular economy and industry 4.0. *International Journal of Information Management*, *49*, 98-113.

Rizos V, Behrens A, Kafyeke T, Hirschnitz Garbers M, Ioannou A (2015). he circular economy: barriers and opportunities for SMEs, *CEPS working document no. 412*/September 2015. Brussels.

Rizos, V., Behrens, A., Van Der Gaast, W., Hofman, E., Ioannou, A., Kafyeke, T., Flamos, A., Rinaldi, R., Papadelis, S., Hirschnitz-Garbers, M., & Topi, C. (2016). Implementation of circular economy business models by small and medium-sized enterprises (SMEs): barriers and enablers. *Sustainability, 8* (11), 1-18.

Rosa, P., Sassanelli, C., Urbinati, A., Chiaroni, D., & Terzi, S. (2020). Assessing relations between circular economy and industry 4.0: A systematic literature review. *International Journal of Production Research, 58*(6), 1662-1687.

Rüßmann, M., Lorenz, M., Gerbert, P., Waldner, M., Justus, J., Engel, P., & Harnisch, M. (2015). Industry 4.0: The future of productivity and growth in manufacturing industries. *Boston Consulting Group, 9*.

Sanders, A., Elangeswaran, Ch., & Wulfsberg,J.P. (2016). Industry 4.0 implies lean manufacturing: Research activities in industry 4.0 function as enablers for lean manufacturing. *Journal of Industrial Engineering and Management, 9*(3):811-833.

Schaltegger, S., & Sturm, A. (1989). Ökologieinduzierte Entscheidungsprobleme des Managements: Ansatzpunkte zur Ausgestaltung von Instrumenten [Ecology induced management decision support. Starting points for instrument formation].*WWZ-Discussion Paper No. 8914*, Basel.

Schmidheiny, S. (1992). *Changing Course: A Global Business Perspective on Development and the Environment*. MIT Press, Cambridge, MA.

Siciliano, A., Stillitano, M.A., Limonti, C. (2016). Energetic Valorization of Wet Olive Mill Wastes through a Suitable Integrated Treatment: H2O2 with Lime and Anaerobic Digestion. *Sustainability*, 8, 1150.

Skene, K. R. (2018). Circles, spirals, pyramids and cubes: Why the circular economy cannot work. *Sustainability Science, 13*(2), 479-492.

Smol, M., Kulczycka, J., & Avdiushchenko, A. (2017). Circular economy indicators in relation to eco-innovation in European regions. *Clean Technologies and Environmental Policy, 19*(3), 669-678.

Tseng, M. L., Tan, R. R., Chiu, A. S., Chien, C. F., & Kuo, T. C. (2018). Circular economy meets industry 4.0: Can big data drive industrial symbiosis? *Resources, Conservation and Recycling*, *131*, 146-147.

Tukker, A., (2015). Product services for a resource-efficient and circular economy – A review. *Journal of Cleaner Production*, *97*, 76–91.

Tukker, A., Bulavskaya, T. Giljum, S, Koning, A., Lutterb, S., Simas, M., Stadlerd, K. & Wood, R. (2016). Environmental and resource footprints in a global context: Europe's structural deficit in resource endowments. *Global Environmental Change*, *40*, 171–181.

Ünal, E., Urbinati, A., & Chiaroni, D. (2019). Managerial practices for designing circular economy business models: IMS. *Journal of Manufacturing Technology Management, 31*(3), 561- 589.

Urbinati, A., Chiaroni, D. & Chiesa, V., (2017). Towards a new taxonomy of circular economy business models. *Journal of Cleaner Production*, 487-498.

Wang, P., Che, F., Fan, S., & Chen, G. (2014). Ownership governance, institutional pressures and circular economy accounting information disclosure. *Chinese Management Studies, 8*(3): 487-501.

Zero project (2020): https://proyecto-zero.com/ (Last access 29th July 2020).

Zhou, K., Liu, T., & Zhou, L. (2015). Industry 4.0: Towards future industrial opportunities and challenges. Paper Presented in 12th International Conference on Fuzzy Systems and Knowledge Discovery (FSKD) in Zhangjiajie, 2147–2152, included in Rajput, S., & Singh, S. P. (2019). Connecting circular economy and industry 4.0: SSIS. *International Journal of Information Management, 49*, 98-113.