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Collaborations for Service Innovation in low-tech sectors:
Evidence from SMEs Italian wineries

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Chapter 1. Thesis Overview

1.1 Introduction

The last few decades have been characterized by a significant change in the structure of economic production. The service economy has dominated in the industrialized world (the USA and Europe), accounting for over 70% of gross domestic product, and continues to grow (Schwab, 2016). Advocates of service-oriented strategies emphasize the economic, strategic and environmental benefits of pursuing an innovative service-oriented strategy (Classen and Friedli, 2019).

To survive in developed economies, it is widely believed that firms can rarely remain pure manufacturing firms (Neely, 2007). The transition to services is generally a strategic need to overcome the maturity phase of the product, which leads to a contained growth in turnover (Kowalkowski et al., 2017). The transition to an experience economy has made service innovations ubiquitous and essential to create economic growth and well-being (Ordanini and Parasuraman, 2010).

In the beginning, this approach was defined in the literature with the acronym of "servitization" (Vandemerwe and Rada, 1988). Manufacturing servitization has become a standard business practice that allows customers to obtain Product-Service Systems (PSS) tailored to their needs. In turn, it allows companies to better position themselves on the market (Baines et al., 2009). More in detail, "PSS is a system of products, services, networks of actors and support infrastructures that continually strives to be competitive, to meet customer needs and to have a lower environmental impact than traditional businesses "(Goedkoop et al., 1999, page 5).

Therefore, the adoption of a servitization strategy entails important cultural and managerial challenges (Oliva and Kallenberg, 2003; Slack, 2005; Baines et al., 2009).

In response to these challenges, innovation in general and especially in services becomes a strategic option for manufacturing companies of any size, but above all for SMEs (Rosenbusch, Brinckmann and Bausch, 2011).

SMEs have a substantial influence on the economy of most countries (Agostini & Nosella, 2018; Wright et al., 2015). The importance of SMEs for economic growth has been recognized in the academic literature with attention to their strategic behavior (Rosenbusch, Brinckmann and Bausch, 2011), to the growth and development of various types of innovations (Oliva and Kallenberg, 2003; Baines et al., 2009). Studies on small and medium-sized manufacturing enterprises suggest that innovation is a necessary prerequisite to keeping one's competitive performance as stable as possible (Liao, Rice, 2010).

However, manufacturing SMEs wishing to innovate in services face several problems. In this sense, the set of managerial actions becomes crucial, consciously aimed at providing the company with both the consolidation and the evolution of key knowledge to maintain its competitiveness (Paniccia, 2006). These companies may not have the resources and competencies necessary to develop innovation, especially if they operate in low-tech or mature sectors, characterized by a low rate of innovation introduction (Yoon et al., 2012). For this reason, the SMEs, to obtain all the information necessary for the development of innovations, need to open their horizons towards the external environment in which they operate. In this context, the literature shows that SMEs rely less on internal development to drive their innovation and more on external collaboration to overcome resource constraints and drive innovation (Classen et al., 2012).

The subject of this study are SMEs exclusively producing wine, a clear example of the need to keep up with the times. Today the classic cellar is not seen as it once was, where the manufacturing was the fulcrum of company life, but is now seen as the promoter of a territorial system of services that complete and illuminate the experience of wine lovers in the cellar. The company not only sells bulk wine and therefore concentrates all its knowledge and strength in the creation of a good wine but is making a step towards the sale of a system of accessory services that frame its bottle of wine in a more attractive environment for its consumers.

To overcome these problems, SMEs in general, and in particular those of wine, must cooperate with external partners to obtain those resources and competencies necessary for the implementation of new innovative practices. For this reason, the collaboration of wine SMEs with external partners broadens the range of internal knowledge and can support the development of new innovative practices. However, to successfully access new knowledge through collaborations with the external environment, companies must develop the competencies necessary to search, find, access, and interpret for their use information embedded in external organizations (Forfás, 2005), i.e., they must improve their absorptive capacity, known in the literature as ACAP (Zhara and George, 2002).

In light of these considerations, this work aims to analyze how wine SMEs can develop innovation in services and how the improvement of the absorptive capacity can be a precondition for making collaborations with external agents in the development of new innovative practices.

1.2 Structure of the thesis

The thesis has its roots in an in-depth analysis of the literature relating to the phenomenon of Servitization in manufacturing companies that intend to improve their innovative performance.

The next chapter analyzes the literature in the context of Servitization and the Product-Service System, and then builds a theoretical framework that will be the starting point of the entire work. I

analyzed the publications made using the keyword "Servitization* and Product-Service System*", this allowed me to carry out a bibliometric analysis and to identify future directions for research.

The third chapter of a qualitative nature focuses on structured interviews with small and medium-sized enterprises (SMEs) in the wine sector. This paper aims to investigate whether and how Sicilian wine SMEs apply the Product-Service System (PSS), in a logic of servitization, with the contribution of external agents, in particular universities, being important entities that hold the knowledge that can be mixed with corporate ones.

Finally, in the fourth chapter, I examined the mediating role assumed by the external collaboration that the wine manufacturing SMEs can establish with various partners, becoming an important aid, through which the Absorptive Capacity allows companies to generate various types of innovation.

1.3 Abstracts

- **Paper 1** (Chapter 2): This article aims to map the development of studies related to servitization and Product-Service Systems (PSS) to examine and discuss the main findings of the scientific literature. The study is based on co-occurrence analysis, co-citation analysis and bibliographic coupling of 421 articles selected using Vosviewer software. By identifying thematic clusters, the study underlines the growing interest in the field of servitization and the development of a product-service system. In recent times, in addition to the development of the architecture of services, solutions, and Product-Service System, the development of strategic methods of servitization and PSS, the authors are opening a new field of research by combining digitization with these new business practices, demonstrating the characteristics of servitization research. Several research gaps emerged from this literature review. This bibliometric analysis is based solely on the Web of Science databases. The future use of other databases such as Inspec, EI Compendex and Scopus is not excluded. In addition, the work provides an overview of the servitization literature using a bibliometric analysis to identify key research topics. Next, the study examines the concept of PSS to detect the evolution of the literature and its definition and implementation.
- **Paper 2** (Chapter 3): This article intends to investigate whether and how Sicilian wine SMEs use the Product-Service System (PSS), in a logic of Servitization, with the contribution of external agents, the Universities, to enrich their knowledge and competencies. This work conducted 8 semi-structured interviews with Sicilian wineries. A qualitative analysis of the case studies was developed. The research data were analyzed with the help of the Nvivo software. The results highlighted, on the one hand, the importance that collaborations with universities could have, on the other hand, the difficulty of the wineries and the approach to

these organizations. Despite this, important collaborations with other external agents emerged. The study has limitations common to any qualitative analysis of companies in a single region, the results cannot be generalized. Additionally, the study provides input on how companies operating in low-tech industries can implement servitization (PSS) through in-depth collaborations with external providers of complementary knowledge and competencies.

- **Paper 3** (Chapter 4): In relatively stable industries, a company generally has the resources to gain and maintain a competitive advantage. However, in highly turbulent markets, these resources are unlikely to remain valuable and may fail to improve the firm's competitiveness. As SMEs do not possess internally all the resources necessary for the development of new innovative practices, which may involve product, process and service innovations, they must develop external links to access knowledge located outside the borders or to find sources of knowledge that facilitate the creation and combination of new technologies. To acquire new knowledge, companies need to know where and how to find it, and how to assimilate and disseminate it through their corporate structure. For this reason, the collaboration of companies with various external partners broadens their range of knowledge and can support the development of new innovative practices.

This work, using the SmartPLS software, intends to investigate the mediation role assumed by the external collaboration that the wine manufacturing SMEs can establish with various partners, becoming a driving force through which, the Absorptive Capacity (AC) allows companies to generate various types of innovation.

The main results show that Collaboration (even if little studied in this sense) has a very important role in the context of SMEs, as the acquisition and enhancement of external knowledge is very significant for these realities to maintain their competitive advantage.

This work brings with it some limitations typical of the empirical analyzes of a specific sector.

1.4 Overall Contributions

1.4.1 Contributions of the thesis

The study offers several research contributions in the field of Servitization, and therefore of service innovation, in manufacturing SMEs. Firstly, this thesis contributes to broadening the literature about Servitization and the introduction of a Product-Service System (PSS) in a manufacturing SME. These strands usually, in traditional literature, were treated separately, but in this work, to give a complete vision of the phenomenon of Servitization, and therefore the introduction of innovation and PSS, I wanted to integrate the various contributions to grasp those points of contact that otherwise they

would be lost. For this reason, the evolution of concepts in this area was highlighted, reaching out towards a Digital Servitization, very useful for manufacturing SMEs that intend to keep up with the times.

Secondly, it adds a piece to the understanding of the behavior of SMEs when they decide to start collaborations with the outside world, but above all with universities. This is a sector in continuous growth, due to the high importance assumed by this entity in the production and dissemination of scientific-technological knowledge and not between small and large industrial partners. Despite the importance of external collaboration, through direct contact with manufacturing SMEs, obstacles have been highlighted in establishing collaborations in the academic field. Universities often have a different and more technical language than manufacturing SMEs. This type of company, approaching the world of services, for them still to be discovered, finds it difficult to communicate with universities, either because of the closed approach of the employees or because of the lack of monetary resources.

Finally, this work aims to emphasize, more and more, the importance of absorptive capacity, as an effective driver for establishing collaborations with sector partners, but also with external partners such as research centers and universities, in the process of development and improvement of innovative performance of low-tech SMEs. In recent years, due to the growing importance of technologies and innovations, studies have focused on high-tech companies, in this sense, the work tries to fill this gap.

1.4.2 Contributions during the PhD

Submissions:

- Cutugno Mariapia, Abbate Tindara, Cesaroni Fabrizio, Crupi Antonio, (2021). “Servitization and Product-Service System: a literature review”, International Journal of Service Science (UNDER REVIEW).

Conference Presentations:

- Cutugno Mariapia, Abbate Tindara, Cesaroni Fabrizio, (2021). “Servitization and Product-Service System: a bibliometrics analysis”, 14th Annual Conference of the EuroMed Academy of Business, In Contemporary Business Concepts and Strategies in the new Era, pp. 187-199.
- Cutugno Mariapia, Abbate Tindara, Cesaroni Fabrizio, (2020). “Relationship between universities and wine companies: The case of Tasca D'Almerita”, 13th Annual Conference of the EuroMed Academy of Business, In Business Theory and Practice Across Industries and Markets, pp.1318-1320.

- Cutugno Mariapia, Abbate Tindara, Cesaroni Fabrizio, (2020). “Service innovation in the wine sector: evidence from Sicilian firms”. Sinergie - Sima Management Conference, pp.235-239.
- Cutugno Mariapia, Abbate Tindara, Cesaroni Fabrizio, D'Amico Augusto (2019), “Tourism and Disability: An Interpretative Framework”, Sinergie - Sima Management Conference, Rome, pp.267-271.

Chapter 2. Servitization and Product-Service Systems: a literature review

2.1 Introduction

The business environment for the manufacturing industry has changed significantly (Zhou and Song, 2021) because a well-designed product is no longer considered a criterion for a clear competitive advantage. Numerous sectors are moving towards providing advanced services to their customers (Kowalkowski et al., 2015; Martinez et al., 2010; Reim et al., 2016). This domain concerns manufacturing companies that move from the development, production and sale of products to innovation, sale and provision of services, more precisely of a Product-Service System (PSS) (Davies, 2004; Gebauer et al., 2010; Oliva and Kallenberg, 2003; Tukker, 2004; Ulaga and Reinartz, 2011). The transition to services is generally a strategic need for overcoming the maturity phase of the product, which leads to a contained growth in turnover (Kowalkowski et al., 2017).

This priority had already been addressed less than twenty years ago when servitization was first mentioned (Vandemerwe and Rada, 1988). Manufacturing servitization has become a standard business practice that allows customers to achieve product-service combinations tailored to their needs. In summary, it will enable companies to better position themselves on the market (Baines et al., 2009). This phenomenon is an ever-evolving process of change (Baines et al., 2017). Most of the articles are not based on a specific theory of implementation of servitization and the Product-service system (PSS). But they try to provide a general overview of these research fields, leaving out the conceptual aspects, which could be very fruitful for research development, which may emerge from a more in-depth analysis of implementation contexts of the servitization and development of a PSS (Martín-Peña et al., 2017). Specifically, this work aims to identify and better conceptualize the development of servitization in manufacturing companies that strive to maintain their competitive advantage in a constantly evolving world, introducing a PSS in their offer.

Servitization implies a complete shift from the traditional product-based business model towards a new approach more focused on meeting customer expectations and promoting services associated with its use (Gaiardelli et al., 2021). This change involves the provision of the so-called PSS: "A system of products, services, networks of actors and support infrastructures that continually strives to be competitive, to meet customer needs and to have a lower environmental impact than the traditional businesses "(Goedkoop et al., 1999, p. 5).

The concept of PSS is not new. The first article discussing PSS was published in 1999 (Goedkoop et al., 1999). After more than 20 years of research, PSS has grown into a rich and diverse field. Related concepts include integrated solutions (Windahl et al., 2004), service transition (Kowalkowski et al.,

2015), service infusion (Kowalkowski et al., 2017), total care product (Alonso-Rasgado et al., 2004; Liu et al., 2018), an integrated offer of products and services (Paivarinne et al., 2016; Nilsson et al., 2018).

Due to the extensive research in the PSS field, it is necessary to conduct a more focused scientific review to get a complete picture of the existing literature by studying the main pillars on which the theory is founded and investigating the main research areas covered by the literature focused on the development of servitization and PSS. More than 40 review articles have been published so far. Some concentrate on the definition, characteristics, and potential benefits of PSS; others, on the other hand, have dedicated themselves to identifying effective methodologies for the implementation, development and design of a PSS. While there have been many previous reviews, most of them used a subjective and qualitative analysis. With this in mind, the document aims to map the development of studies related to servitization and Product-service Systems (PSS), examining and discussing the main results available in the scientific literature. The literature analysis is articulated around two main dimensions: servitization and the development of a PSS.

The contribution of this review is twofold. First, it provides an overview of the servitization literature using a bibliometric analysis to identify the main research topics. Second, it examines the concept of PSS to highlight the evolution of the literature on the subject and its definition and implementation. The data analyzed in this document referred to 421 articles selected on the Web of Science (WoS) and explored through VOSviewer. The analysis focused on the development of co-occurrence analysis, co-citation analysis, and finally, bibliographic coupling, highlighting the main thematic areas of reference in the literature.

This article is structured as follows: the methodological section describes the data collection process and introduces bibliometric analysis and tools. Next, the results section illustrates the search results. Furthermore, based on the latter, the development status and future trends of the PSS servitization and research sector are discussed and deepened.

2.2 Theoretical background: Servitization and Product-Service system (PSS)

The growth of services in manufacturing companies has become one of the most active services research domains, to the point that it has been identified as a strategic research priority (Ostrom et al., 2015). This domain concerns companies moving from product development, manufacturing, and sales to innovation, sales, and service delivery (Davies, 2004; Gebauer et al., 2010; Oliva and Kallenberg, 2003; Tukker, 2004; Ulaga and Reinartz, 2011).

Vandermerwe and Rada (1988) first discussed the servitization of manufacturing firms, who referred to creating value by adding services to product offerings. This process is driven by increasingly

complex customer requests and the need to defend against the competition (Santamaría et al., 2012). If implemented successfully, services can become an essential source of revenue and profits, ensure customer satisfaction and loyalty, and support business growth (Eggert et al., 2014; Fischer et al., 2012). For this reason, companies belonging to numerous sectors are moving towards the provision of advanced services to their customers (Kowalkowski et al., 2015; Martinez et al., 2010; Reim et al., 2016). Several factors, including product differentiation, competitive advantage, new and recurring revenue streams, and profitability, drove this organizational change (Kowalkowski et al., 2017; Lenka et al., 2017; Oliva and Kallenberg, 2003).

As a notable result of the servitization strategy, manufacturers can offer PSS (Chang et al., 2014). These PSSs can bring products closer to the customer and customize services to a greater extent than traditional products. Bundling products and services are beneficial because services tend to lock the customer in a long-term relationship (Cohen et al., 2006; Tukker, 2004; Vandermerwe and Rada, 1988). Furthermore, alongside strategic and economic advantages, some PSSs have the potential to bring about changes in consumption patterns that can accelerate the shift towards more sustainable practices (Goedkoop et al., 1999, Manzini and Vezzoli, 2003; Mont, 2002; Sundin et al., 2009; Tukker, 2004, 2015).

There is no generally accepted definition of PSS (Tukker, 2015). The act of combining products and services is essential for a PSS. The first authors who started talking about the Product-service system were Goedkoop et al. in 1999: PSS was seen, and still is mentioned as "A system of products, services, networks of actors and support infrastructures that continually strives to be competitive, to meet customer needs and to have less impact environmental compared to traditional business models "(p. 5). Most recently, Tukker and Tischner (2006, p. 1552) they tried to redefine the PSS as, for example, define PSS as "a mix of tangible products and intangible services designed and combined in such a way that they are jointly able to meet the needs of the end customer".

Various analysis points are used to distinguish between products and services in the literature, such as heterogeneity, contextuality, and storage. Instead, Tukker and Tischner (2006) use intangibility as a preponderant factor of differentiation between products and services (Zhang et al., 2012). Intangibility or degree of material intensity refers to the fact that services are not based on the material. This implies that something can be physically stored (Kuijken et al., 2017).

To develop an effective PSS, in the sense that customers perceive intrinsic value, the products and services that make up the PSS must have "standalone" value for customers. Having standalone value means that products and services may be sold separately as standalone offerings on the market. In addition to having an autonomous value, the combination of products and service elements in a PSS should be 'super additive' or synergistic (i.e., the whole is rated higher than the sum of its parts) rather

than 'additive' (i.e., the total is equal to the sum of its parts) (Kuijken et al., 2017). This is also confirmed by Shankar et al. (2007), suggesting that PSS systems, by incorporating products and services, are systems that create more customer benefits than those that would have been available separately.

Although in theory there are many benefits of a PSS, for example, financial advantages, strategic advantages, etc., in practice, manufacturers often struggle to improve their performance by developing and marketing a PSS (Baveja et al., 2004; Benedettini et al., 2015; Gebauer et al., 2005; Matthysens and Vandenbempt, 2010; Neely, 2008; Spring and Araujo, 2013; Stanley and Wojcik, 2005; Ulaga and Loveland, 2014; Ulaga and Reinartz, 2011). In part, this appears to be because knowledge on how to develop, manage and market PSS effectively is still emerging (Benedettini et al., 2015; Reim et al., 2015; Spring and Araujo, 2009).

2.3 Methodology

The literature for the present study was collected using the Web of Science database. This database is recognized to cover a wide range of relevant journals and high-quality peer-reviewed articles (Skute et al., 2019). Although the scientific database landscape is vast (Inspec, El Compendex, Scopus, etc.), the study follows a methodology previously used in past reviews focused on literary inquiry (Zhou and Song, 2021; Skute et al., 2019). To carry out this analysis, this study used VOSviewer 1.6.15 (Van Eck and Waltman, 2017). VOSviewer is a software tool for creating and visualizing bibliometric networks (Van Eck and Waltman, 2017). This analysis was conducted by developing the following research strategies: Co-occurrence analysis, Co-citation analysis, and Bibliographic coupling (Skute et al., 2019; Zhou and Song, 2021; Crupi et al., 2020; Van Eck and Waltman, 2014). More specifically, co-occurrence analysis is an effective method for exploring research topics and new search trends because keywords provide a concise and accurate high-level summary of the document (Fang et al., 2017). The VOSviewer tool can extract keywords from the document and then calculate the frequency. Finally, it acquires a keyword occurrence matrix used for keyword recurrence analysis (Park and Nagy, 2018). The second method used is the analysis of co-citation: it is a dynamic method because the co-citation frequency will increase over time, thus reshaping the structure of knowledge (Van Eck and Waltman, 2017). Due to the accumulation of citations over time, the citation analysis can trace its roots in knowledge by identifying the main works of a discipline (Vogel and Güttel, 2013). Finally, the last method is bibliographic coupling which allows the construction of coupling networks for different units of analysis, such as publications, journals, and researchers (Waltman and Van Eck, 2012). In a correspondence analysis of the researchers' literature, the kinship of researchers is determined by the degree to which they cite the same publications. The more often two researchers

cite the same publications, the stronger their kinship is (www.vosviewer.com). Kessler (1963) proposed that bibliographic coupling occurs when two words refer to a third common work in their bibliographies, and the coupling strength of two given documents depends on the number of citations they share. Using these methodologies, thematic clusters have been built to explain and illustrate better the theoretical pillars and the main research areas on which the servitization and PSS literature is based.

To present the results obtained, the similarity visualization technique (VOS) was adopted (Van Eck and Waltman, 2017, 2014, 2010). In detail, the displayed clusters were classified by counting the frequency of the terms and analyzing the content of titles, abstracts, and keywords of the grouped publications.

2.3.1 Sample selection

To identify the most relevant publications, as previously mentioned, a bibliometric analysis was conducted using the following search strategy: the keywords used in this document were: Servitization * or "Product-service system *"; thanks to these keywords, we have focused more on the reference topic, given that in the research field there are the same abbreviations of PSS which, however, refer to other research areas. In our first search, 2666 articles came out (see figure 1).

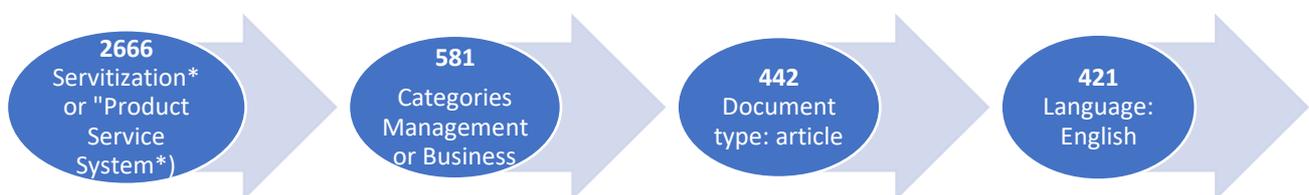


Fig. 1 Selection Process

To refine the search, by removing the references that would only have been misleading, filters were applied: the first was to define the search areas by specifying the business and management area; subsequently, only the newspaper articles were considered; finally, the English language was chosen. At the end of the screening, 421 articles on servitization and PSS were found.

2.4 Results

2.4.1 Co-occurrence analysis

Co-occurrence analysis is an effective method for exploring research topics and new search trends because keywords provide a concise and accurate high-level summary of the document (Fang et al., 2017). This methodology extracts the keywords from the paper and subsequently calculates the

2.4.2 Co-citation analysis

Figure 3 shows the results of the co-citation analysis between articles on servitization and the PSS.

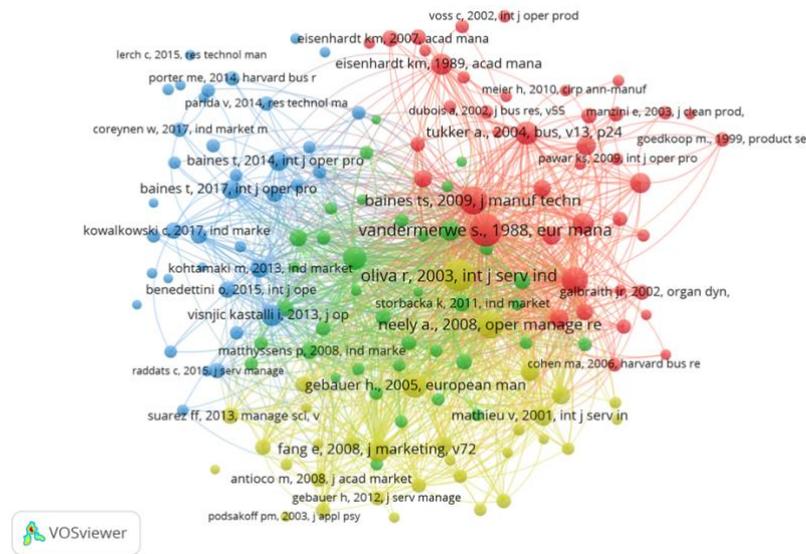


Fig. 3 Co-citation analysis

The bibliometric network displayed is structured in 4 interconnected clusters with distinctive references deriving from the citations obtained from the reference dataset with 16593 corresponding citations. To make the analysis more precise, we referred to articles that have had at least 20 citations. The final number of references examined is 149 articles. This choice is justified because a more detailed and targeted analysis reduces the risk of an excessive representation of publications not focused on the topic (Kovacs et al., 2015; Skute et al., 2019). Each scientific article displayed in the figure represents a single cited publication, grouped with neighboring publications based on the likelihood of being cited and other articles. Articles incorporated into the same group show a higher likelihood of being cited together by other elements. Different colors identify clusters. Furthermore, each publication shows a specific weight, represented by the size of its circle, based on the total connecting strength of the article and the number of citations received.

Using the co-citation technique, the contribution in the context of servitization and PSS can be illustrated through four thematic clusters, classified according to the authors' content analysis.

2.4.2.1 CLUSTER 1 (red): Towards services

The studies belonging to this cluster focus on exploring the conceptualization of servitization and subsequently on identifying the first approaches to implementing this innovative practice.

Recent thinking has focused on the "dematerialization" of the economy, reducing the flows of materials in production and consumption; creating products and services that provide consumers with the same level of performance (Mont, 2002). This new, more service-oriented model of

manufacturing growth has key competitive factors such as the capacity for continuous innovation, improved design and quality, and customized goods, rather than the production of large volumes of standardized products (Mont, 2002).

The first conceptualization of the transition to services, and therefore of servitization, was made by Vandermerwe and Rada in their 1988 article in the *European Management Journal* entitled "Servitization of business: adding value by adding services". They defined servitization as the largest offering of more complete market packages or bundles of customer-focused combinations of goods, services, support, self-service and knowledge to add value to key product offerings.

We are in the presence of a reconceptualization of the original business model of a typical manufacturing company: in this context, the company wants to acquire value from the introduction of services in its offer to the public but encounters implementation difficulties because it deals with innovations beyond their previous experience, where their prior beliefs and practices do not apply (Chesbrough, 2002).

Like the table, I show us, in the literature, we have approached the world of servitization under various business aspects, for example, do Vargo and Lusch (2008b) carry out and conceptualize in more detail the Dominant Logic of the focuses on service processes rather than the output in the form of a product offer that is exchanged (Vargo and Lusch, 2004, 2008a, b). SDL allows the entrepreneur to see service as a transcendent mental model for all types and forms of tangible or intangible innovation. Therefore, with this approach, the attention has shifted sharply from the characteristics of any outputs to their value or experience, which is created with the participation of other actors, in fact, Vargo and Lusch (2008a), in this context, propose that value be obtained from the integration of competences and knowledge, defined as operational resources to achieve the value in use.

In this creation of value for the customer, promoting the development of a PSS could be a step forward in implementing effective servitization practices (Baines, 2007, 2009). According to the work of Tukker (2004), the PSS is a set of products that are manufactured and sold with unique characteristics for complete customer satisfaction, of services with their commercial value, and finally of a system, seen as a collection of key elements which allows the establishment of lasting relationships with customers, maximizing the value in use.

In conclusion, table 1 shows the ten most relevant articles within the first cluster.

AUTHOR	PAPER	CITATION
Vargo and Lusch, 2004	Evolving to a new dominant logic for marketing	17884
Vargo and Lusch, 2008a	Service-dominant logic: continuing the evolution	8035

Chesbrough, 2002	The role of the business model in capturing value from innovation: evidence from Xerox Corporation's technology spin-off companies	6304
Vandermerwe and Rada, 1988	Servitization of business: adding value by adding services	2900
Mont, 2002	Clarifying the concept of product–service system	2509
Tukker, 2004	Eight types of product–service system: eight ways to sustainability? Experiences from SusProNet,	2424
Baines, 2007	State-of-the-art in product-service systems	2329
Baines, 2009	The servitization of manufacturing; a review of literature	1883
Wise and Baumgartner,1999	Go downstream.	1809
Vargo and Lusch, 2008b	From goods to service (s): Divergences and convergences of logics,	1307

Table I: Top ten articles (Cluster 1: Towards services)

2.4.2.2 CLUSTER 2 (green): Dynamics capabilities to maintain the competitive advantage

All of the world's most advanced economies are dominated by services, many of which have more than 70% of their gross domestic product (GDP) generated by services. The growth of services is expected to continue unabated for these countries (Ostrom et al., 2010). Countries that have historically focused on manufacturing are also experiencing rapid growth in services (Ostrom et al., 2010). In the industrial context, maintaining one's competitive advantage in the reference market can be a significant challenge (Barney, 1991). Efforts often don't translate into higher margins and/or marketers may not have the creativity to differentiate their offering significantly (Matthyssens and Vandenbempt, 2008).

For this reason, manufacturing companies are opening their horizons towards the introduction of services in their offer to the public. This transition can lead to the internal research or development of new competencies necessary for implementation (Allmendinger and Lombreglia, 2005). This cluster includes works that explore the use of new dynamic competencies that allow the maintenance of one's competitive advantage.

Indeed, Teece et al. (1997) focus their work on dynamic capabilities to underline the exploitation of existing internal and external company-specific competencies to face evolving environments. These dynamic functionalities can be disaggregated to sensitize and model opportunities and threats, seize opportunities and maintain competitiveness through the improvement, combination, and protection of internal and external knowledge. Dynamic capabilities include hard-to-replicate business capabilities needed to adapt to changing customers and technology opportunities (Teece, 2007).

Therefore, dynamic capabilities seek to adopt a company's resource base to evolving customer demands and market trends, such as increased demand for services and businesses to shape their environment through innovation and collaboration with its customers and other key players (Teece, 2007, Tuli et al., 2007).

The resources used for this process are productive assets that the firm possesses. Instead, the capabilities are what the firm can do; resources by themselves do not confer a competitive advantage but must be transformed into capabilities to do so (Ulaga and Reinartz, 2011). Suppose an organization can create such sources of competitive advantage. In that case, it may translate them into a better cost position than its competitors or differentiate itself from its competitors, which should increase its revenues (Ulaga and Reinartz, 2011; Brady et al., 2005).

These claims are reinforced by the work of Kindström et al. (2013), which reaffirms the need for a sometimes completely new extension of the armory of initiatives and underlying processes if a company offers its customer product service solutions aims to remain competitive. This finding goes beyond the concepts and micro-foundations that previously underpinned traditional product operations of firms to the innovative behavior necessary to develop such dynamic capabilities that facilitate and support innovation in service delivery (Kindström et al., 2013; Tuli et al., 2007).

Table II shows the top ten most influential articles within the second cluster.

AUTHOR	PAPER	CITATION
Barney, 1991	Firm resources and sustained competitive advantage	79732
Teece et al., 1997	Dynamic capabilities and strategic management	40709
Teece, 2007	Explicating dynamic capabilities: the nature and microfoundations of (sustainable) enterprise performance.	11784
Ostrom et al., 2010	Moving forward and making a difference: research priorities for the science of service	1874
Tuli et al., 2007	Rethinking customer solutions: From product bundles to relational processes.	1535
Ulaga and Reinartz, 2011	Hybrid offerings: how manufacturing firms combine goods and services successfully.	991
Brady et al., 2005	Creating value by delivering integrated solutions	658
Kindström et al., 2013	Enabling service innovation: A dynamic capabilities approach	591
Matthyssens and Vandenbempt, 2008	Moving from basic offerings to value-added solutions: Strategies, barriers and alignment.	543
Allmendinger and Lombreglia, 2005	Four strategies for the age of smart services	529

Table II. Top ten articles (Cluster 2: Dynamics capabilities to maintain the competitive advantage)

2.4.2.3 CLUSTER 3 (blue): Intelligent revolution in servitization

The third cluster takes into consideration the relationship between digitization and servitization. Service studies tend to see IoT, digitization, and IT functionality as inherently related to servitization (Vendrell-Herrero et al., 2017), full servitization would not exist without actual data capture, storage,

analytics and use, across a variety of sensors, data warehouse, data analysis and user interfaces, which allow to effectively serve the installed base or increase customer value by improving the use of the fleet of products in use (Opresnik and Taisch, 2015; Ardolino et al., 2018; Martín-Peña et al., 2018). Without a well-developed business model, innovators will neither deliver nor capture value from their innovations (Teece, 2010). Drivers include the emerging knowledge economy, the growth of the internet and e-commerce, the outsourcing and relocation of many businesses, and the restructuring of the financial services industry around the world (Teece, 2010). In particular, the way companies make money today is different from the industrial era, where products were relatively important and the value capture thesis was relatively simple - that is, the firm simply bundled its technology and intellectual property into a product it has sold, either as a discrete item or as a bundled package (Teece, 2010; Kastalli and Van Looy, 2013).

Digital servitization is defined as the transition process from pure products and additional services to intelligent product service systems (Baines et al., 2017).

Smart products and services offer exponentially expanding opportunities for new features, far greater reliability, much higher product utilization, and capabilities that transcend and transcend the boundaries of traditional products (Porter and Heppelmann, 2014). The changing nature of products also disrupts value chains, forcing companies to rethink and reorganize almost everything they do internally. These new types of products alter the industry structure and the nature of competition, exposing companies to new competitive opportunities and threats (Porter and Heppelmann, 2014).

Intelligent, and therefore somewhat advanced, products and services raise a new set of strategic choices related to how value is created and captured, how the prodigious amount of new (and sensitive) data they generate is used and managed, how relationships with traditional business partners how channels are redefined and the role companies should play when industry boundaries are expanded (Baines and Lightfoot, 2014; Visnjic et al., 2016). For a long time, studies have seen the opportunities that digitization is generating for companies providing solutions, suggesting that these industrial companies need to develop capabilities to seize these opportunities (Vendrell-Herrero et al., 2017; Cusumano et al., 2015). Even though a company may use its business model and resources and innovation capabilities to take advantage of current product-based opportunities, manufacturing companies hardly understand how the resources and capabilities that underpin production extend to enable service innovation (Kindström and Kowalkowski, 2014).

Table III shows the ten most important articles within the third cluster.

AUTHOR	PAPER	CITATION
Teece, 2010	Business models, business strategy and innovation.	8943
Porter and Heppelmann, 2014	How smart, connected products are transforming competition.	2635

Kastalli and Van Looy, 2013	Disentangling the impact of service business model innovation on manufacturing firm performance	658
Baines and Lightfoot, 2014	Servitization of the manufacturing firm	442
Cusumano et al., 2015	Services, industry evolution, and the competitive strategies of product firms	420
Kindström and Kowalkowski, 2014	Service innovation in product-centric firms: A multidimensional business model perspective.	410
Baines et al., 2017	Servitization: revisiting the state-of-the-art and research priorities.	407
Opresnik and Taisch, 2015	The value of big data in servitization.	402
Visnjic et al., 2016	Only the brave: Product innovation, service business model innovation, and their impact on performance.	334
Vendrell-Herrero et al., 2017	Servitization, digitization and supply chain interdependency	323

Table III: Top ten articles (Cluster 3: Intelligent revolution in servitization)

2.4.2.4 CLUSTER 4 (yellow): Service strategies

The growth of services in manufacturing companies has become one of the most active services research domains, to the point that it has been identified as a strategic research priority (Fang et al., 2008). Thus, servitization is often described as a transition, in which the company moves from providing pure standalone additional products and services to maintenance contracts, operational services, and ultimately results-based or performance-based offerings (Huikkola and Kohtamäki, 2018; Mathieu, 2001a, b; Oliva and Kallenberg, 2003). The production and delivery of services involve considerable contact between the organization and customers; customers frequently delivered service production activities performed at the organization-customer interface (Bowen and Larsson, 1989).

Advocates of service-oriented strategies point to the economic, strategic and environmental benefits of pursuing a service-oriented approach. Services are attractive because they are characterized by high margins and stable revenues (Brax and Jonsson, 2009; Gebauer et al., 2005). From a strategic perspective, services can establish a close and long-term relationship with customers, which at the same time locks in competitors. Furthermore, integrated solutions are less easy to replicate, making them a lasting source of differentiation (Chesbrough, 2011; Mathieu, 2001a, b; Neely, 2008; Oliva and Kallenberg, 2003).

An organization's ability to successfully develop servitization can be a key to sustaining competitive advantage in the rapidly changing environments in which most companies compete (Neu and Brown, 2005).

In essence, the strategy must align with the organization's design factors, and both sets of internal factors must be designed to adapt to the conditions of the external environment (Neu and Brown, 2005, Sawhney et al., 2003). Although emphasis has been placed on identifying organizational designs that promote effectiveness in different environments, organization-environment adaptation has also been used to explore the appropriate design, effectiveness and influence of parts of organizations (Neu and Brown, 2005).

Table IV shows the list of the most relevant articles of the reference cluster.

AUTHOR	PAPER	CITATION
Oliva and Kallenberg, 2003	Managing the transition from products to services.	3058
Neely, 2008	Exploring the financial consequences of the servitization of manufacturing	1557
Gebauer <i>et al.</i> , 2005	Overcoming the service paradox in manufacturing companies	1082
Mathieu, 2001a	Service strategies within the manufacturing sector: benefits, costs and partnership.	852
Fang <i>et al.</i> , 2008	Effect of service transition strategies on firm value	799
Mathieu, 2001b	Product services: from a service supporting the product to a service supporting the client.	715
Bowen and Larsson, 1989	Organization and customer: managing design and coordination of services.	657
Sawhney <i>et al.</i> , 2003	Creating growth with services	582
Neu and Brown, 2005	Forming successful business-to-business services in goods-dominant firms	568
Gebauer, 2008	Identifying service strategies in product manufacturing companies by exploring environment–strategy configurations	454

Table IV: Top ten articles (Cluster 4: Service strategies)

2.4.3 Bibliographic coupling

The methodology employed in this section follows the same process as the previous co-citation analysis. In line with this, we have selected from the reference dataset (421 articles) all articles that have received at least 20 citations (Kovacs *et al.*, 2015; Skute *et al.*, 2019), thus narrowing our reach, focusing on only 101 articles. As previously done, this search strategy was made to include only high-impact previous research in the context of servitization and PSS research.

Based on this type of analysis, all the references on servitization and PSS have been classified into five clusters (as seen in Figure 4).

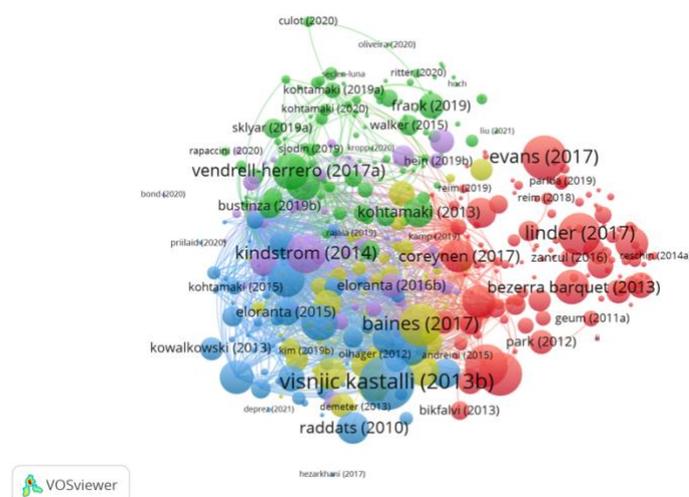


Fig. 4 Results of bibliographic coupling

2.4.3.1 CLUSTER 1 (red): Innovative operational management

As we enter the twenty-first century, the business environment for the manufacturing industry has changed significantly (Lightfoot, 2013). Well-designed products are no longer considered criteria for a clear competitive advantage in manufacturing industries (Datta, 2011). This vision can strengthen customer relationships, create new and resilient revenue streams, and set high barriers for competitors (Baines, 2014). Manufacturers now tend to include more services in their total offering to facilitate the sale of their products (Evans, 2017). In this context, the reference cluster contains the works that refer to the operational management of servitization and PSS, both from the purely managerial side and from the side of innovation that this transition can bring within the company.

Researchers from managerial disciplines and perspectives recognize that servitization and PSS could change the way companies produce and customers consume (Bezerra Barquet, 2013). A service-oriented approach provides new ways of dealing with businesses, customers and the value chain. As a result, this approach has received increasing attention from manufacturing companies seeking opportunities for competitive advantage ((Bezerra Barquet, 2013). Although companies consistently offer services to the market, only in recent years have they seen the integration of products and services as a chance for growth and competitiveness (Lightfoot, 2013).

The basic assumption is that the customer's value may lie in the benefits obtained from the product rather than the ownership of the product itself, suggesting that the supplier could shift the focus from the means to obtain those benefits (Smith, 2014).

Once the company has identified its ability to create and the market's ability to accept new offers, it is necessary to design more or less digital PSS offers. Often these new offerings will require new competencies, resources and partnerships (Linder, 2017). Product companies need to respond to the demand-driven service innovation model. At the same time, they also need strong investment in new technologies and connectivity to compete in the technology push model set by competitors (Frank, 2019). Consequently, this development process will greatly impact the company's innovation management systems, creating the need for new tools and processes and new capabilities (Lerch, 2015).

To achieve an integrated and balanced system, deliberate interaction, collaboration, networking and learning from multiple and diverse stakeholders are essential. It is no longer a choice for companies to engage with stakeholders or not. The challenge is rather how to engage successfully (Evans, 2017). Innovation research generally suggests two alternative strategies: either invest in R&D to radically transform the company's core technology competence (Tongur, 2014) or transform the company's value proposition by incorporating the product into functional sales and systems of product-service (Vandermerwe and Rada, 1988). The first strategy involves investing in research and development to

gain a competitive advantage through a stronger technological position and a different technology that creates value (Adler, 1989). The second strategy involves forward integration and expansion of the value proposition to include a broader scope than a specific underlying technology (Tongur, 2014).

The cluster's most cited papers are listed below.

AUTHORS	PAPER	CITATION
Baines, 2014	Servitization of the manufacturing firm	443
Lightfoot, 2013	The servitization of manufacturing: A systematic literature review of interdependent trends	423
Bezerra Barquet, 2013	Employing the business model concept to support the adoption of product-service systems (PSS)	308
Smith, 2014	Servitization and operations management: a service dominant-logic approach	272
Tongur, 2014	The business model dilemma of technology shifts	270
Lerch, 2015	Digitalized Product-Service Systems in Manufacturing Firms: A Case Study Analysis	263
Evans, 2017	Business Model Innovation for Sustainability: Towards a Unified Perspective for Creation of Sustainable Business Models	250
Linder, 2017	Circular Business Model Innovation: Inherent Uncertainties	224
Frank, 2019	Servitization and Industry 4.0 convergence in the digital transformation of product firms: A business model innovation perspective	193
Datta, 2011	Operations strategy for the effective delivery of integrated industrial product-service offerings: Two exploratory defence industry case studies	139

Table V. Most cited papers (Cluster 1: Innovative operational management)

2.4.3.2 CLUSTER 2 (green): Success and failure of services

This group of articles explores how manufacturing companies make the transition from manufacturers to service providers. Existing research suggests that shifting to service delivery requires a substantial shift in development capabilities (Story, 2017; Raddats, 2010). This transition can lead to both a positive and a negative outcome by recording the paradox of service. This phenomenon focuses on the failure to introduce services that do not register the expected revenues (Kowalkowski, 2017a). While a company may use its business model and innovation resources and capabilities to take advantage of current service-based opportunities, companies rarely understand how the resources and capabilities underpinning manufacturing extend to enable servitization (Spring and Araujo, 2013; Ulaga and Reinartz, 2011). When they do, their resources and capabilities may be insufficient, or even counterproductive, to take advantage of service innovation opportunities (Kindstrom, 2014). There is evidence that companies may have overextended in moving towards service in many industries, and some are withdrawing from certain service initiatives, a process we call deservitization (Kowalkowski, 2015). Benedettini (2015) argues that, even if a company overcomes the paradox of service by growing its service business and generating a healthy financial return, it could still encounter apparently unsolvable cultural and attitudinal challenges. Indeed, inculcating a service culture, which involves changing employees' mindsets accustomed to a product-centric view, could

be the main barrier for companies seeking to take advantage of servitization (Kowalkowski, 2017b; Davies et al., 2006).

In addition to this type of barrier, servitization can also have positive feedback for the implementing company. In the literature, the introduction of advanced services is increasingly being studied, documenting the motivations and advantages of competing through this level of service (Baines, 2017). These include growth in revenue and profits (Raddats, 2010), improving responses to customer needs (Ostrom et al., 2010), improving product innovation (Eggert et al., 2011), creating of new revenue streams (Baines and Lightfoot, 2013), increasing customer loyalty (Gaiardelli et al., 2014b; Saccani et al., 2014) and placing more significant barriers to competition (Baines, 2017; Oliva and Kallenberg, 2003; Durugbo, 2014).

Hence, these factors have increasingly motivated the change of manufacturing companies. For this, the offer of products-services can lead to financial benefits in the form of higher profit margins and more stable income (Parida, 2014).

Second, the addition of service components to physical products offers strategic advantages in the form of greater inimitability (Parida, 2014). Industrial services enable manufacturing companies to achieve product differentiation by customizing their product and service offerings to meet different customer needs (Gebauer and Fleisch 2007). Finally, the addition of service components has been found to increase the attractiveness of the product component market, leading to greater sales growth (Parida, 2014). In this way, industrial products-services offer manufacturing companies a strategic opportunity to secure a long-term competitive advantage (Parida, 2014; Kohtamaki, 2013).

The most cited articles belonging to the second cluster are listed below.

AUTHORS	PAPER	CITATION
Kindstrom, 2014	Service innovation in product-centric firms: a multidimensional business model perspective	410
Baines, 2017	Servitization: revisiting the state-of-the-art and research priorities	408
Kowalkowski, 2015	What service transition? Rethinking established assumptions about manufacturers' service-led growth strategies	301
Benedettini, 2015	Why do servitized firms fail? A risk-based explanation	272
Kowalkowski, 2017a	Servitization and deservitization: Overview, concepts, and definitions	270
Kowalkowski, 2017b	Service growth in product firms: Past, present, and future	228
Raddats, 2010	Services growth options for B2B product-centric businesses	217
Parida, 2014	Mastering the Transition to Product-Service Provision: Insights into Business Models, Learning Activities, and Capabilities	193
Kohtamaki, 2013	Making a profit with R&D services — The critical role of relational capital	169
Story, 2017	Capabilities for advanced services: A multi-actor perspective	154

Table VI. Most cited papers (Cluster 2: Success and failure of services)

2.4.3.3 CLUSTER 3 (blue): Implementation of servitization

The production strategy has traditionally been based on one, or a combination, of three paradigms: vertical integration of supplier-buyer production and supply of processes for controlling and forecasting the input and output flow, investment in research to bring to market products that are superior to the competition or to generate a sustainable market position to strengthen economies of scale (Bustinza, 2015). As manufacturers move to service-centric strategies, which require additional and valuable capabilities for companies and reshape value creation channels, those foundations need to be revised (Bustinza, 2015; Crozet, 2017; Bastl, 2012).

The addition of services, or the reconception of products as services, allows manufacturers to create value throughout the product lifecycle and capture it not only from the company's current position in the value chain but along the entire value chain, generating new revenue streams (Bustinza, 2015).

This cluster investigates, through many case studies, the practical way of implementing servitization. The propensity towards servitization can change the modus operandi of companies and their perception of innovation (Santamaria, 2012; Visnjic, 2016). Companies are aware that the provision of services is often more complex than the production of products and requires the development of different approaches (Santamaria, 2012; Vendrell-Herrero, 2017).

Servitization or service innovation can be seen as developing an organization's innovation capabilities by making a shift from products to product-service systems, thus better satisfying customer needs and avoiding the trap of commodification (Visnjic Kastalli, 2013a, b). More precisely, in the work of Visnjic Kastalli (2013a), they explored a case study, which was able to conceive a business model in which products and services act as complements to turnover and generate a spiral of turnover growth between them, overcoming the substitution intrinsic of products with services.

Going back in the literature, a work by Schmenner (2009) stands out, investigating the structure and the profitable relationships that can be established in a supply chain: in a first analysis, companies were very close towards the customer and his needs, Over the years, customer focus has become increasingly important, assuming the manufacturer has significant control over the downstream elements of his supply chain.

A wide range of examples of servitization can be found in the literature on automobile manufacturers, the aerospace industry, machine tools, printing machines and other capital goods (Baines et al., 2009). Typical examples of the services provided include installation and training, after-sales services (including product repair and maintenance, customer service and recycling of goods at the end of their life cycle), inspection and financial or insurance services (Santamaria, 2012).

In detail, the introduction of services promises to provide differentiation where the main product is becoming a commodification (Macdonald, 2016). One example is Rolls-Royce's archetypal

TotalCare solution, which began in 1997 with American Airlines, which combines an engine and its service into a long-term contract. Since the manufacturer maintains reliability data for numerous airlines, it can accurately predict and prevent engine problems, provide a reliability advantage, and reduce the airline's financial risk (Macdonald, 2016).

Table 7 shows the top ten most cited articles in this reference cluster.

AUTHORS	PAPER	CITATION
Visnjic Kastalli, 2013a	Servitization: Disentangling the impact of service business model innovation on manufacturing firm performance	658
Visnjic, 2016	Only the Brave: Product Innovation, Service Business Model Innovation, and Their Impact on Performance	334
Vendrell-Herrero, 2017	Servitization, digitization and supply chain interdependency	323
Schmenner, 2009	Manufacturing, service, and their integration: some history and theory	281
Santamaria, 2012	Service innovation in manufacturing firms: Evidence from Spain	260
Macdonald, 2016	How Business Customers Judge Solutions: Solution Quality and Value in Use	231
Bustinza, 2015	Servitization and Competitive Advantage: The Importance of Organizational Structure and Value Chain Position	190
Bastl, 2012	Buyer-supplier relationships in a servitized environment: An examination with Cannon and Perreault's framework	189
Visnjic Kastalli, 2013b	Steering Manufacturing Firms towards Service Business Model Innovation	180
Crozet, 2017	Should everybody be in services? The effect of servitization on manufacturing firm performance	164

Table VII. Most cited papers (Cluster 3: Implementation of servitization)

2.4.3.4 CLUSTER 4 (yellow): Networks of digital servitization

In the literature, the potential of digitization has often been discussed in a manufacturing context. For example, advanced manufacturing technologies offer the ability to standardize and customize simultaneously (Coreynen, 2017). They can also serve to break existing boundaries of cost-effectiveness by reducing transaction costs and the need for scale. Furthermore, information and communication technologies (ICT) offer possibilities for greater customer-supplier interaction and the "capture" of customer needs (Sklyar, 2019).

For example, companies such as Ericsson, IBM and GE are increasingly selling complete innovative solutions rather than autonomous physical products with simple additional services to better satisfy the customer (Parida, 2015). Service innovation offers the potential to create and market new services and new product-service combinations to provide added value to the customer (Parida, 2015).

The literature has also found that success in global service innovation requires companies to develop capabilities that support a greater intensity of relationship and interaction between headquarters and local units, customers, and service partners (Parida, 2015).

Research has shown that sufficient service reach and agility can be achieved by developing smart solution networks (Eloranta, 2016).

In recent years, the importance of digitization for servitization has been increasingly mentioned, with the exploitation of ICT defined as one of the foundations of service science (Coreynen, 2017). Coreynen investigated case studies, which explained how digitalization could allow manufacturing companies to offer a higher level of value-added services to their customers. This is why, the increase in servitization is fraught with risks and barriers, which often require new capabilities (Coreynen, 2017).

This trend towards digitization is also transforming how manufacturing companies interact with their customers by enabling new connected product capabilities and integrating various operational processes to increase opportunities to co-create value through advanced service offerings (Lenka, 2017). Organizations must design new capabilities, business models and processes to enable and support this paradigm shift (Eloranta, 2015).

Contemporary research suggests that the customer and the supplier co-create value together in a joint sphere through direct interaction in this value creation process (Lenka, 2017). In the manufacturing context, the collaborative option with stakeholders (suppliers, customers, etc.) has become increasingly attractive (Eloranta, 2016). These contests are made up of both highly interdependent economic actors, dependent on each other for survival, and more distant but still critical parties as regulators and policymakers (Overholm, 2015; Hein, 2019). The ecosystem concept contributes a new level of opportunity analysis, devoid of the current discourse on opportunities with its focus on individual entrepreneurs, private social networks and pricing functions in markets (Overholm, 2015).

Below is a list of the ten most important citations in cluster 4:

AUTHORS	PAPER	CITATION
Coreynen, 2017	Boosting servitization through digitization: Pathways and dynamic resource configurations for manufacturers	290
Lenka, 2017	Digitalization Capabilities as Enablers of Value Co-Creation in Servitizing Firms	201
Eloranta, 2015	Seeking competitive advantage with service infusion: a systematic literature review	158
Parida, 2015	Developing Global Service Innovation Capabilities: How Global Manufacturers Address the Challenges of Market Heterogeneity	139
Eloranta, 2016	Platforms in service-driven manufacturing: Leveraging complexity by connecting, sharing, and integrating	128
Overholm, 2015	Collectively created opportunities in emerging ecosystems: The case of solar service ventures	124
Sklyar, 2019	Organizing for digital servitization: A service ecosystem perspective	104
Hein, 2019	Value co-creation practices in business-to-business platform ecosystems	86
Walker, 2015	Theoretical perspectives in operations management: an analysis of the literature	82
Wallin, 2015	Understanding product-service system innovation capabilities development for manufacturing companies	79

Table VIII. Most cited papers (Cluster 4: Networks of digital servitization)

2.4.3.5 CLUSTER 5 (purple): Service architecture

As we have seen in previous clusters, in the literature, there is a focus on conceptualization and on how companies develop servitization and insert PSS in their offer to the public. However, there are still few works that investigate the architecture and modularity of services.

According to Brax (2017a), the term servitization can be associated with changes in the positions that companies occupy in the value flow of the sector, with changes in the type and scope of market offerings of companies, with the shift of orientation from business models focused on the product towards dominant business models on the service or centered on the customer, and finally to observed or requested changes in structures, capacities and relationships at the organizational and network level.

So, at the base of servitization, there are services in all their facets. Thanks to Sousa (2017), we characterize the servitization strategies based on the offer of Basic Services (BAS) and Advanced Services (ADS). BAS aims to install and maintain the basic functionality of the product. ADS refers to working closely with customers to co-create value that goes beyond the basic operation of the product, involving the adaptation of the use of the product to the specific needs of the customer and the situation of use. This distinction is based on how value is co-created and appropriate by the servitized unit and the customer, which is at the heart of the performance explanation (Sousa, 2017). For a few years now, however, a path has been opening up that runs through the architecture and modularity of services. Architecture is a broader concept that includes product modularity, component complexity, product platforms, loosely coupled interfaces, component commonality, and many components (Brax, 2017b). Product architecture decisions are closely related and include how systems are broken down, the selection of components to be used, and how these components are aligned with each other (Field, 2018).

In the following table, there are a few articles that make up the last reference cluster.

AUTHORS	PAPER	CITATION
Brax, 2017a	Meta-model of servitization: The integrative profiling approach	155
Sousa, 2017	Capability antecedents and performance outcomes of servitization: Differences between basic and advanced services	81
Brax, 2017b	Service modularity and architecture – an overview and research agenda	72
Field, 2018	Service operations: what's next?	59

Table IX. Most cited papers (Cluster 5: Service architecture)

2.5. Discussions

The emergence in the literature of the words servitization, service innovation, digitization, manufacturing enterprise, business model innovation and capability (see Fig. 2) in recent years shows

a trend towards interdisciplinary integration. Interdisciplinary actors will further merge to generate some interesting research opportunities in the age of digitization, e.g., digital servitization and PSS (Liu et al., 2020), and the balance between environmental, digital and cost elements servitization.

In addition to using the co-occurrence method to identify the concepts that researchers most use, this work focused on the development of co-citation analysis and bibliographic coupling. These methodologies made it possible to divide the 421 papers collected into clusters via the Web of Science database.

First, thanks to the co-citation analysis, we arrived at a classification of 4 conceptual clusters: Cluster 1 (Towards services) and Cluster 4 (Service strategy) are completely theoretical clusters for the definition of the concept of servitization and PSS and first attempts to identify implementation practices. In fact, at a conceptual level, it all hinges on Vandermerwe's definition and who defined servitization as "the greater offer of more complete market packages or bundles of customer-focused combinations of goods, services, support, self-service and knowledge. To add value to key product offerings". Subsequently, implementation theories were outlined such as the Vargo and Lusch SDL (2008-2009), which focuses on the value that the product and service system can give to the customer through the use of the same package. Instead, the remaining clusters, Cluster 2 (Dynamics capabilities to maintain the competitive advantage) and cluster 4 (Intelligent revolution in servitization), outline specific research paths that have recently been born, especially the integration of digitization in support of the implementation of servitization.

Summarizing all the articles that focus on the development of dynamic capabilities that allow the maintenance of competitive advantage, it is increasingly convinced that, when manufacturing companies intend to carry out the transition towards servitization, they must integrate and then further develop their internal capacities with the needs and all the inputs that may derive from the external environment, from the market itself, from consumers, suppliers, public and private research bodies, in summary, all the collaborations and interactions of information and knowledge can be valuable resources for a servitized company.

Another research path that has recently expanded is digital servitization, a beautiful opportunity for companies that provide integrated solutions and PSS, suggesting that these industrial companies must increasingly develop these features to best all the fruitful things that this digital approach can lead to the implementation of servitization (Vendrell-Herrero et al., 2017).

Secondly, this study used bibliographic coupling to outline the thematic areas on which the literature on servitization and PSS is based. Also, in this analysis, we arrived at the definition of 5 conceptual clusters, which have outlined three paths that the research on servitization is gradually developing. The first aspect that emerges is the part of identifying definitions accepted by the research community

to make the definition of the servitization phenomenon clearer, being a very vast field, because not only a sector of production can develop this practice, but it affects everything. The productive world, here, is the interdisciplinarity of matter (Liu et al., 2020).

The further streams are characterized by the attention to the collaboration networks that can be established between companies that have different competencies that mutually benefit both: especially in the field of digitization, the increase in servitization is fraught with risks and barriers, which often require new capacities (Coreynen, 2017) held by other specialized companies. Finally, in recent years, as demonstrated by Cluster 5 (Service architecture), attention has increased on the conceptualization of services, especially their architecture and possible modularity. This is reinforced by the work of Sousa (2017), which classifies the servitization offering into Basic Services (BAS) and Advanced Services (ADS). BAS aims to install and maintain the basic functionality of the product. ADS refers to working closely with customers to co-create value beyond the product's basic functioning.

Thanks to an in-depth examination of all the thematic clusters, we can say that there are literary gaps that will have to be filled in the future. First, there is limited attention to how a PSS is developed in small and medium-sized enterprises with low levels of innovation. Secondly, in line with Cluster 2 (Dynamics capabilities to maintain the competitive advantage), there is an increasing need to understand how internal competencies are developed and managed, knowing that manufacturing companies do not have much knowledge of the services. Therefore, it will be necessary to investigate the type of competencies and valuable knowledge for the implementation of servitization in a manufacturing company in the future.

2.6 Conclusions

This article conducts a literature review using a bibliometric analysis of the research body of servitization and PSS using co-occurrence analysis, co-citation analysis, and finally, bibliographic coupling. The analysis of the results of the co-citation analysis shows that the research themes in the fields of servitization and PSS are grouped into four conceptual clusters as Towards services, Dynamics capabilities to maintain the competitive advantage, the intelligent revolution in servitization and finally, Service strategy. Instead, with the help of bibliographic coupling, we have outlined five conceptual clusters that touch on the implementation practices of servitization and PSS, the opportunities for success or failure of servitization, the field of digitization in support of servitization, and finally, a new field of research of the architecture of the services. As demonstrated in the results, in recent times, in addition to the development of the service architecture, the authors, in addition to developing strategic methods of servitization and PSS, are opening a new field of

research by combining digitalization with these new business practices, demonstrating the dynamic characteristics of servitization research. We performed bibliometric analyzes of servitization and PSS research with a simple and objective knowledge mapping technique. The search procedure is transparent and the results can be reproduced in other search fields using the same approach. The paper provides insights that reveal the distribution structure of literature globally. The study has some limitations that offer suggestions for further investigation. This bibliometric analysis is based solely on the databases of the Web of Science. The future use of other databases such as Inspec, EI Compendex and Scopus is not excluded.

Furthermore, bibliometric analysis is a popular research method that allows scholars to examine the previous and future growth of scientific work. Still, it also has some weaknesses, such as evaluating scientific work without considering that citations take time to accumulate. In the future, the content analysis method can be used to assess the quality of research and extract the results of a study.

2.7 References

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Chapter 3. Exploring service innovation in Sicilian wineries: A qualitative approach

3.1 Introduction

The last few decades have been characterized by a significant change in the structure of economic production. The service economy has dominated in the industrialized world (the USA and Europe), accounting for over 70% of gross domestic product, and continues to grow (Schwab, 2016). Advocates of service-oriented strategies emphasize the economic, strategic and environmental benefits of pursuing an innovative service-oriented strategy (Classen and Friedli, 2019).

To survive in developed economies, it is widely believed that SMEs can rarely remain pure manufacturing firms (Neely, 2007). The transition to an experience economy has made service innovations ubiquitous and essential to create economic growth and well-being (Ordanini and Parasuraman, 2010).

In the beginning, this approach was defined in the literature with the acronym of "servitization" (Vandemerwe and Rada, 1988). This phenomenon is an evolving process of organizational change (Baines et al., 2017); therefore, manufacturing SMEs, to maintain their market share, try to change their orientation, the traditional production processes, for the implementation of this innovative managerial practice.

Adopting a servitization strategy involves major cultural and managerial challenges (Oliva and Kallenberg, 2003; Slack, 2005; Baines et al., 2009).

Adding services to physical goods requires the acquisition and expansion of one's knowledge of services, integrating it with that of the material goods offered. In this sense, the set of managerial actions, consciously aimed at providing the company with both the consolidation and the evolution of key knowledge to maintain its competitiveness, becomes crucial (Paniccia, 2006).

For SMEs, it could be a very important obstacle. In fact, these companies may not have the required resources and competencies, especially if they operate in low-tech or mature industries, characterized by a low rate of innovation introduction (Yoon et al., 2012), such as the wine SMEs.

To overcome these problems, SMEs need to cooperate with external partners to obtain the resources and competencies necessary for the implementation of new products and sales approaches, such as Product-Service System (PSS). Among the various partners, who can range from customers, suppliers, competitors, there is a category that deserves all the attention that is that of university, which can be classified as a huge cauldron containing all the knowledge, competencies and resources of which the company, in this crucial moment, may need (Giuliani and Arza, 2009).

In recent years, universities and research centers have focused their attention on improving and strengthening relations with industry, with the ultimate goal of promoting regional and national economic development and innovation systems (Etzkowitz and Leydesdorff, 2000; Giuliani and Arza, 2009; Cesaroni and Piccaluga, 2016). Therefore, the ability of companies to acquire, use and integrate external sources of knowledge has been recognized as one of the most relevant competitive factors, in particular for SMEs interested in adopting a servitization process. (Baines et al., 2007).

Developing the concepts set out above in the continuation of the work, an attempt is made to answer the research questions: do wine SMEs develop servitization by applying the PSS? In implementing this approach, to what extent does this type of company make use of external agents, especially universities, with the aim of enriching internal competencies and knowledge not previously possessed?

To answer these research questions, this work carried out interviews with 8 manufacturing companies, belonging to the Sicilian wine sector. The interviews focused on three specific aspects, in particular, the introduction of product, process and service innovations: and finally, the collaborations with the external environment, with any reference stakeholder.

This study made it possible to identify the reference services that wineries develop in their offer to the public, and subsequently facilitated the positioning of wine SMEs in the continuum of servitization promoted by Tukker, 2004. From the results that emerged, SMEs have established collaborations with external agents that have allowed the development of innovative parts not in the context of the services offered but in other business areas, such as sustainability, new and more productive cultivation practices.

This article is structured as follows: the theoretical background section provides theoretical guidelines for adapting key concepts in business practice; then the methodology describes the process of conducting the interviews and the manipulation of data through the Nvivo software. In addition, the results section illustrates the search results. Based on the latter, the corollaries of servitization and the development of a PSS are discussed and deepened, with the fruitful contribution that collaboration with external agents, and therefore universities, can give.

3.2 Theoretical background

Servitization and Product-Service System (PSS)

The term "servitization" was first introduced in the late 1980s by Vandermerwe and Rada, after interviewing senior executives from service and manufacturing companies, by arguing that servitization is a trend in which "more and more companies around the world add value to their core business offerings through services" Vandermerwe and Rada (1988, p. 314–324).

More recently, Brax and Visintin (2017) conducted a systematic review of the literature to propose a meta-model of servitization and offered a more pragmatic definition: "servitization of production is conceptualized as a process of change whereby a production company deliberately or in an emerging fashion introduces service elements into its business model" (p. 18).

Therefore, servitization cannot be described only as of the inclusion of additional elements in a company's service offering portfolio or the proposal of integrated solutions (Resta et al., 2017). Rather, it can be defined as the gradual and coherent evolution of the entire organization of a manufacturing firm (Teece, 2010; Zott et al., 2010) including its value proposition, capacity, organizational structure, role and position in the supply chain for value creation, as well as its relationships with customers.

When competing through a servitization strategy, firms are positioned along a "product-service continuum" (Oliva and Kallenberg, 2003; Neu and Brown, 2005; Gebauer, 2008). At one extreme is the traditional manufacturer who mainly offers products, while services are rarely offered or are considered ancillary to their products; the weight of services on total revenues is very low and contained. At the opposite extreme, there is the service provider, whose main offer consists of services and goods that can be added to meet the customer's needs: in these cases, the weight of services on total revenues is preponderant (Tenucci and Supino, 2019).

Due to the complexity of the phenomenon, reference is made to the complete definition of the term servitization by Baines et al. (2009, p. 555): "Servitization is the innovation of an organization's capabilities and processes to better create mutual value through the transition from selling products to selling the Product-Service System (PSS)".

The idea of providing more value to the company through the integration of products and services has a specific weight in the SME literature and serves as a link to another research stream, related to the concept of PSS (Chang et al., 2014).

The term PSS originated in Northern Europe, mainly in the Netherlands and Scandinavia, in the late 1990s (Goedkoop et al., 1999). There is no generally accepted definition of PSS in the literature (Tukker, 2015). According to Tukker and Tischner (2008, p. 1552), PSS is defined as "a mix of tangible products and intangible services designed and combined in such a way as to be jointly able to meet the needs of the end customer". Consequently, a PSS can be defined as a served business model. To reach this new dimension, a coherent and integrated design and management of innovative PSS business models are required (Resta et al., 2017), which will drive the incremental evolution from a product-oriented transactional approach to result (Tukker, 2004).

Scholars argue that thanks to its innovative and convergent nature, PSS enables enterprises to become more dynamic and improve their ability to withstand the rigidity of business caused by high market

competition, fragmented customer demand, and accelerating of innovation (Almeida et al., 2008; Beuren et al., 2013; Park et al., 2012).

Adopting a servitization strategy offers numerous benefits to manufacturers, such as higher profit margins, more stable sources of profit, and less vulnerability to cash flow, which is a powerful strategic weapon and marketing argument for selling more products (Baines et al., 2007; Mathieu, 2001b).

The most common forms of PSS (see Table 1) available in the literature is the following (Tischner and Verkuijl, 2002; Baines et al., 2007; Tukker, 2004; Neely, 2008):

Service typology	PSS category
Consulting Services	Integration-Oriented PSS
Financial Services	
Property and Real Estate Services	
Retail and Distribution Services	
Transportation and Trucking Services	
Design and Development Services	Product-Oriented PSS (POS)
Installation and Implementation Services	
Maintenance and Support Services	
Outsourcing and Operating Services	
Procurement Services	
Training Services	
Updating/Upgrading Services	Service-Oriented PSS (UOS)
Systems and Solutions Services	
Leasing Services	Use-Oriented PSS (UOS)
Service Level Agreement and Extended Warranty Services	Result-Oriented PSS (ROS)
Recycling Services	

Table 1. Classification of Service typology and PSS categories (Source: Neely, 2008)

- Product Oriented Services (POS): which involves the sale of a product in the traditional way, in which the customer retains ownership of the product, although it includes some associated services. For example, after-sales service to ensure functionality and durability of the product. In this case the company is motivated to introduce a PSS to minimize the costs of use during the life cycle of the product;
- User Oriented Services (UOS): When the product is owned by the manufacturer, who sells the use or functions of a product. In this case, the company is motivated to create a PSS to maximize product use, meet demand, extend product life and reuse materials;
- Results Oriented Services (ROS): where customers and service providers agree on the desired results, without specifying the product in question;

- Integration Oriented PSS: Providing services through vertical integration, a very common practice in the manufacturing sector. Typical applications of this type of PSS are retail and distribution services;

PSS-based business models, which enable the sharing economy, introduce even more challenges and risks (Damali et al., 2020). The literature on these aspects is not complete and exhaustive: companies are very aware of the challenges to be faced, but they do not yet have references for correct implementation, as the inefficient allocation of competencies and internal resources would consume a large part of the profit margins from services without contributing substantial income; this situation is, as it is called in the literature, the "paradox of service" (Kryvinska et al., 2015).

Enrichment of knowledge and collaboration with universities

The transition to more service-like entities, i.e., the process of developing a PSS, requires manufacturing companies to move up the value chain (Finne and Holmström, 2013; Neely, 2008) and to adopt innovative practices and technologies (Baines et al., 2009, 2011). This determines a successful situation for the company only if accompanied by changes in the strategies adopted, in the organizational culture and in the people who work and collaborate within the organization (Oliva and Kallenberg, 2003; Wise and Baumgartner, 1999).

Therefore, the addition of services to physical goods requires the acquisition and dissemination of specific knowledge of services, not being completely material knowledge but essentially abstract knowledge and not easy to find, as it could be for a physical good (Gebauer, 2008; Rabetino et al., 2017). In this sense, the set of all possible managerial actions becomes crucial, aimed at providing the company with both the consolidation and the evolution of the key knowledge to maintain its competitiveness (Paniccia, 2006).

This involves significant investments and, since "the smaller the knowledge gap between new and old practices, the greater the likelihood of resistance to the new way of working" (Hartmann et al., 2010, p. 1167).

Acquisition of knowledge is a prerequisite for change (Rouse et al., 2011) that facilitates the servitization and development of a PSS (Lertsakthanakun et al., 2012) because the transition from product production to service provision means entering in new markets with a new combination of tangible products and intangible services, without fully knowing the characteristics of the latter.

Furthermore, the combination of knowledge from different fields leads to numerous problems, which will influence the organizational learning process (Brown and Duguid, 2001); only an effective knowledge organization system will allow the organization to obtain a competitive advantage (Carlile, 2004).

Furthermore, since the development of a PSS often involves specific competencies and resources that may not be available in an SME (Davies, 2004; Paiola et al., 2013), these may not have them, especially if they operate in low-tech sectors or mature sectors, characterized by a low rate of innovation introduction, such as the wine sector (Yoon et al., 2012). Therefore, collaboration with other partners and suppliers may be necessary (Pawar et al., 2009; Spring and Araujo, 2009), underlining the importance of the exchange of knowledge between these actors: developing a correct network of relationships, concretely promoting a change of ways to generate new innovative practices (Chesbrough and Crowther, 2006; Almirall and Casadesus-Masanell, 2010; Dahlander and Gann, 2010).

The search for external sources aims to identify valuable inputs from customers, suppliers, competitors, universities and other public research bodies, to activate knowledge transfer processes outside organizational boundaries and direct efforts towards the implementation of new innovative practices (Von Hippel, 1988; Katila and Ahuja, 2002; Laursen and Salter, 2006).

Among the plurality of potential external sources, many studies have recognized universities as a fundamental source of external knowledge (Laursen and Salter, 2006; Chen et al., 2011), thanks to the ability of academic knowledge to have positive spillover effects on the enrichment of the internal knowledge of companies (Jaffe, 1989).

In low-tech manufacturing SMEs, the introduction of new innovative practices, and thus the inclusion of a PSS in their public offering, is often based on the transformation of general basic knowledge into economically useful knowledge, which involves internal experimentation, learning, estimating and evaluating existing technologies (Santamaría et al., 2009). In this context, universities can represent a valid alternative for acquiring knowledge, as SMEs can access the competencies of academic staff and the technical facilities they need for the development of new products and services (George et al., 2002).

Indeed, universities can strongly contribute to technological and economic progress, given their unique capabilities that can support the generation of integrated solutions that provide benefits to other organizations (Chen et al., 2012). In particular, universities are generators and owners of scientific knowledge, which is one of the fundamental resources to obtain a valuable and broad development of all the techniques to implement new ways of thinking, selling and maintaining the desired competitive advantage (Ambos et al., 2008).

Academic engagement was therefore defined as "knowledge-related collaboration by academic researchers with non-academic organizations" (Perkmann et al., 2013, p. 424).

Universities are increasingly seen as central actors in the economic development processes of countries and regions. In recent times, their direct involvement with industry has increased and

policies have been designed to promote networking between universities and industry (Cesaroni and Piccalunga, 2016), universities have become a relevant source of innovation also for firms in low-technology sectors (Abbate et al., 2020).

Therefore, the ability of companies to acquire, use and integrate external sources of knowledge held by universities and other external agents, has been recognized as one of the most relevant competitive factors, in particular for companies interested in adopting a servitization process, more precisely a PSS (Baines et al., 2007).

From the literature examined it is evident that, in the case of technological innovations, universities have proved to be fundamental external actors in support of SMEs, for their implementation, especially in the high-tech sectors. In this regard, the same cannot be said for low-tech SMEs that intend to develop innovations that are not merely tangible but intangible type, such as organizational innovations, specifically the development of a PSS. Indeed, the literature is somewhat lacking in this sense: it refers only to the awareness that SMEs lack the resources and competencies necessary for the development of these new innovative practices (Yoon et al., 2012), and not to the need to establish a fruitful collaborative relationship with universities in order to integrate the knowledge already possessed with new ones. To fill this gap existing in the literature, this work aims to understand how SMEs apply a new innovative practice (PSS), and if SMEs develop this practice with the contribution of external agents, and in particular, universities, to enrich their internal knowledge and competencies.

3.3 Methodology

Multiple case approach

This study uses a qualitative methodology based on the multiple case approach (Yin, 2014). Case studies are a useful way to examine the specific phenomenon using data from different primary and secondary sources (Yin, 2009). Due to the real-life context and the complexity of the phenomenon studied, a qualitative research approach and case studies (Yin, 2009) were considered the most appropriate research strategy. Specifically, the context analyzed in this study has been the wine industry in the region of Sicily, Italy.

3.3.1 Reference context

The wine industry has recently undergone radical transformations all over the world, both as regards the characteristics of the market and the production of wine (Archibugi, 2007). In particular, the history of the wine sector in Sicily has recorded a series of events that have radically changed the wineries both at an organizational, productive and associative level (Archibugi, 2007).

These changes took place already in the Second World War, when thanks to the creation of the Common Market Organization (CMO), only the most renowned wineries attempted mass bottling for export.

Over time, significant improvements have been recorded throughout Sicily: with over 100 thousand hectares of specialized vineyards and about 6 million hectoliters of wine produced annually, Sicily is at the top of the Italian wine scene for quantity but also for the quality of the wines produced (LaSicilia.it, 2020).

Sicily can be considered to all intents and purposes a real wine continent, independent and exceptional at the same time, with very different geographical areas of production with a high wine vocation, just think of the area of Marsala, the island of Pantelleria, to Etna, to the whole territory that goes from Vittoria to Syracuse with millennia of wine tradition behind it (Unione Italiana Vini, 2020).

If we add to these results the fact that Sicily is also in first place in Italy for the number of agricultural enterprises led by under 35s, here is a positive sign from an innovative point of view (AltraSicilia.it). In recent years the production of Doc¹ wines, which previously involved a very small percentage of the total regional production, has increased significantly, as has the quantity of packaged product, both Doc and Igt²: it has gone from almost 130,000 hectoliters certified to Doc in the 2012 to approximately 483,000 hl certified in 2017 and, again in 2017, approximately 1,700,000 hl were packaged between Doc and Igp³, equivalent to 226 million 0.75-liter bottles (inumeridelvino.it, 2021).

A further milestone was reached with the introduction of organic farming in the region: Sicily is the first region in Italy for organic vineyard area (24% of the regional total, 29% of the total Italy) (inumeridelvino.it, 2021). The choice of cellars reflects all the innovation processes in the vineyard, in the cellar and beyond: if it is large companies that do business, it is small and medium-sized enterprises that create culture and innovation to be exploited on foreign markets, as evidenced by the high number of medals and prizes awarded to wines, companies, individual oenologists in the most important national and international magazines of the last decade (LaSicilia.it, 2020).

Currently, wine-growing Sicily is experiencing a period of great vitality with the continuous search for qualitative enhancement in its numerous pedoclimatic environments, with its viticultural genetic heritage and with national and international native vines. In short, made in Sicily has conquered the

¹ The Controlled Designation of Origin (DOC) is used as a trademark for quality wines produced in small or medium-sized geographical areas, with characteristics attributable to the grape variety, environment and production methods.

² To obtain the recognition of the typical geographical indication (IGT), the wines must be produced with at least 85% of grapes from the indicated geographical area.

³ The Protected Geographical Indication (PGI) indicates foods and wines that are typical of a specific geographical area and that are produced and / or processed and / or processed there: this means that a specific product, even if processed in the indicated area according to specific methods, can come from a different region or even from abroad.

social and cultural landscape by improving its image in the world. An image of quality, youth, reliability, tradition and modernity, accompanying tradition.

A driving role for the growth of the sector, in fact, is also represented by the export of Sicilian wine, which in 2019 increased its outlet markets, although exports are still very concentrated in some countries: Germany, UK and USA as well as 55% of exports (Unione Italiana Vini, 2020).

3.3.2 Data collection

As already mentioned in the previous section, this work focuses on the Sicilian wine sector thanks to its excellent reputation both in Italy and Internationally, both in terms of the quality of the wine and for the excellence recorded.

Here is the choice of Sicilian wineries, since, being purely manufacturing SMEs, they could have all the difficulties for the development of innovative practices.

Contacts have been made with 26 Sicilian companies that won the "3 Glasses of Gambero Rosso wine" in 2020, as it is an award that is not limited to the evaluation of the quality and taste of the wine but embraces the whole external context, also taking into consideration the services offered to the public.

After the first contact via e-mail, individual interviews were scheduled to understand the companies' approach to the world of servitization. The 8 wineries that gave us their availability within a reasonable time, were interviewed (given the spread of the COVID-19 pandemic at the time the survey was carried out, causing the slowdown of the work itself). The semi-structured interviews were divided into three sections: one relating to the introduction of innovations within the company, to better understand their propensity to develop new internal improvement practices; the second section dealt with the world of services, how they incorporated them into their business processes and what obstacles and opportunities they had encountered; the last section, on the other hand, explored the relationship with universities, whether any collaborations had favored the internal development of the services themselves, or whether such collaborations had led to other results relating to different business areas. The interviews took place in blended mode, lasted on average from 40 to 50 minutes. The subjects who were interviewed were mainly Marketing Managers, Sales Managers, Communications Managers and sometimes even the owners themselves.

The first company interviewed was "Tasca d'Almerita", which operates in the provinces of Palermo, Trapani and Messina. The history of this company has been written for 8 generations, since 1830, with deep respect for tradition, always with an eye to the future. It consists of various estates: the "Tenuta Regaleali", in the province of Palermo, the "Tenuta Capofaro" on the island of Salina, the

"Tenuta Tascante" in the province of Catania, the "Tenuta Sollier de la tour" in Monreale, and finally the "Tenuta Whitaker" in Marsala.

The other company interviewed is "Calabretta Winery", which operates in Randazzo in the province of Catania. Its history is based on the experience of 4 generations of winemakers. It is called "the cellar of the stairs", because to reach it you have to climb the stairs and go underground where, according to the owner, "the wine is refined".

Then we move to Trapani, exactly to Mazzara del Vallo, where the "White Dove" is located. It was born in 1970 and today it refers to 7,500 hectares of vineyards that extend from the coast up to 600 meters above sea level.

Going west of Sicily, in the Val di Noto, you will find the "Feudi del Pisciotto". This winery is in an ancient eighteenth-century fiefdom, expertly restored to house the "Wine Relais", a magical reality located in a rural area yet to be discovered.

Near this area, in the province of Catania, the "Benanti winery" was opened, which was founded in 1734 thanks to Vittorio Amedeo d'Aosta. To date, it can boast a production of about 170,000 bottles of wine per year, destined not only for the regional and national market but also for the foreign market. In the same province, we find the "Nicosia Winery" born in 1898 thanks to Francesco Nicosia, great-grandfather of the current owner. The entrepreneurial turnaround takes place thanks to the tenacity and innovative spirit of the current owner, Carmelo Nicosia, who, by investing in the expansion and restructuring of the vineyards and the construction of a modern cellar, will lead the family business to be the protagonist of the rebirth of wine Sicilian.

Returning to the province of Palermo, there is the Cantina di "Alessandro di Camporeale". It is a company that was born in the early 1900s. Here the new generations rediscover the pride of their own identity, sharing a productive project that has solid roots in the history of this family.

A little further south of the island, in the province of Agrigento, there is the "Cantine Settesoli" founded in 1958. This company aims to maximize the value of the grapes while keeping the territory in good condition by exporting its wine abroad.

3.3.3 Data analysis

The interviews carried out were analyzed using the Nvivo software: in particular, this analysis made it possible to identify a series of Items, inherent to the main services offered, which facilitated the comparison of cases, given that in the literature there is no precise classification of the various services offered within a PSS. This research used a thematic analytical approach to data analysis. It is an iterative process of reading, evaluating and identifying emerging themes and categories that organize and describe data in detail (Braun and Clarke, 2006).

3.4 Results

Table 2 lists all the main services offered by the wineries interviewed:

IDENTIFIED SERVICES	DESCRIPTION
Wine shop	Opening of a small portion of the company used for the direct sale of the wine produced in the cellar, and also of the specialties of the area that can enhance the purchase of wine
Export abroad	Wine transport and delivery all over the world
Consulting	Service that can be provided both pre and post-sale for the correct understanding of the characteristics of the wine, but also for direct interaction with the customer or intermediary, which allows on the one hand to solve any problems that have arisen after-sale, and from other to capture what are the possible needs of the customer or intermediary
Tasting	Tasting proposed or carried out for technical (classification) purposes, where wines and liqueurs are consumed, generally accompanied by various types of snacks.
Visit to the cellar	Opening the doors of the cellar for excursions that allow the customer to experience the cellar firsthand, discovering all the secrets that characterize all stages of production, from cultivation in the rows to bottling.
Catering	Full meal preparation service for customers, where traditional local dishes are tasted accompanied by wine produced by the cellar itself, to contextualize the wine in a typical dinner at the customer's home
Accommodation	Reception in parts of the company where rooms are set up, with a unique atmosphere purely in symbiosis with the whole philosophy of the cellar and the surrounding environment in which it operates
Big event organization	They are events directly related to wine, such as festivals or festivals that integrate and enhance all the culture behind the production of their wine

Table 2. Classification of the main services offered by firms

In particular, in recent years, the wineries have opened to the public a small portion of the company used for the direct sale of the wine produced in the cellar and creating a small retail window for most of the typical products of the area that can enhance the purchase of the bottle of wine.

The wine shop is connected to the visit to the cellar, where the oenologist or the production manager illustrates the various stages of production, handling and bottling of the grapes to the customer. To crown and conclude this experience in the cellar and the vineyard, we pass to the moment of tasting the wine produced; this process will make the customer more aware of the purchase of a single bottle of wine, knowing a priori the entire production process.

At the same time, the wineries, to expand their sales boundaries, approach European and foreign markets, with the export of wine. There has been an increase in exports to European and foreign

countries, which greatly appreciate the quality of Sicilian wine. Inevitably, alongside exports, there is a pre and post-sales consultancy service, which allows you to get closer to the customer by solving problems and satisfying all his needs.

Finally, thanks to the history behind the vineyard, the wineries have re-evaluated all the ancient premises, previously used for the conservation of grapes and barrels, using them as restaurants, or as real relaxation corners with rooms open to the suggestive panorama of the vineyards.

Thanks to this explanation, through Table 3 it is possible to have a clearer and more complete picture of the services that are offered by each winery.

OFFERED SERVICES	COMPANIES INTERVIEWED							
	TASCA D'ALMERITA	CALABRETTA WINERY	COLOMBA BIANCA WINERY	FEUDI DEL PISCIOTTO	BENANTI	NICOSIA WINERY	ALESSANDRO DI CAMPOREALE	SETTESOLI WINERY
WINE SHOP				✓	✓	✓	✓	✓
EXPORT ABROAD	✓	✓	✓	✓	✓	✓	✓	✓
CONSULTING				✓	✓	✓	✓	✓
TASTING	✓	✓	✓	✓	✓	✓	✓	✓
VISIT TO THE CELLAR	✓	✓	✓	✓	✓	✓	✓	✓
CATERING	✓			✓		✓	✓	
ACCOMODATION	✓			✓				
BIG EVENTS ORGANIZATION	✓			✓		✓	✓	✓

Table 3. Business comparison

Most wineries have their Wine Shop inside the cellar, because as a manager of the Nicosia Winery says, "for us it is a prerogative to provide the customer with a space specially designed for a more informed purchase, paying homage to our quality of wine".

All the companies examined export abroad, the main countries highlighted in the interviews are America, Sweden, Germany, Japan and China.

As for visits to the cellar and tastings, these are typical services of these types of companies. They support the sale of their bottle of wine with a 360° experience in the cellar, allowing you to experience firsthand all the stages of processing and bottling the grapes, ranging from cultivation and harvesting of grapes to harvesting and distillation in barrels, bottling and labeling. As underlined by the interviewees (Cantina Settesoli, Tasca, Nicosia): "Our winegrowers and oenologists are very proud to transmit and make public the knowledge and all the secrets that can be revealed to fans of the sector". This need also accompanies the organization of fairs and events in which the working phases are shown, but as Roberta Urso (Cantina Settesoli) exalts "it is also a moment of aggregation, where

our employees also become an active and integral part, opening the doors of their private homes, to let fans taste the typical products of the area".

The restaurant area is complex because it requires large spaces but also personnel specialized in the sector (Cantina Calabretta). Sometimes this service is not administered internally but the cellar gives indications on which restaurants, taverns and trattorias to pay attention to. Despite this difficulty, Tasca d'Almerita, Feudi del Pisciotto, Nicosia and Alessandro di Camporeale have one or more restaurants within them: "to fully grasp the quality of our wine, the glass should be enjoyed in our estates while admiring the whole panorama of our vineyards (Tasca d'Almerita) ".

Thanks to the explanation of the main services offered, we can enrich our knowledge on basic services and advanced services for the development of PSS. Basic services focus on the supply of products, in this case, the bottle of wine, accompanied by essential services that cannot be separated from mere sales, such as transport and pre and post-sales consultancy. Advanced services, on the other hand, are all those services that enrich and enhance a certain type of product, such as catering, tasting.

Therefore, based on the literature examined, the company that wants to develop services must be placed along a "product-service continuum" (Neu and Brown, 2005; Gebauer, 2008), as illustrated by Tukker (2004) (see figure 1),

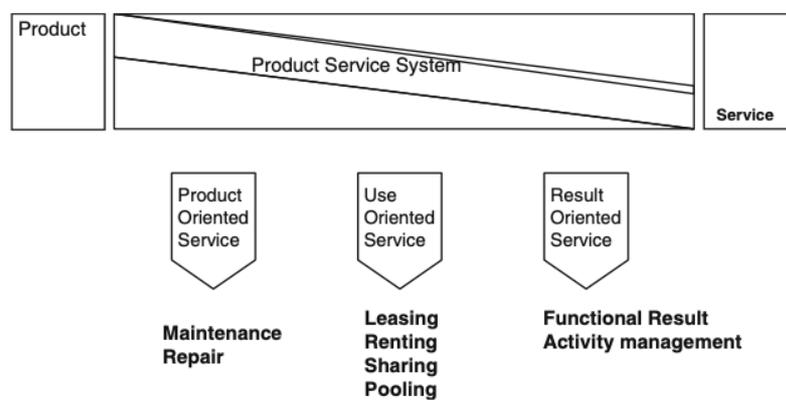


Fig. 1 PSS classification (Source: Tukker 2004)

where at one extreme there is the traditional manufacturer who mainly offers products, while services are rarely offered or are considered ancillary to their products. At the other extreme is the service provider whose main offer consists of services and goods that can be added to meet the customer's needs.

Taking this information into consideration and analyzing the interviews carried out, it can be highlighted that the need of wineries is to increasingly place themselves towards a business model that can both embrace basic services and increasingly approach advanced services. This can be a particular need of wineries: they do not want (advanced) services to overwhelm their main activity,

the production and bottling of wine, but that they enrich their offer to the public, allowing them to maintain their share of the market and, why not, acquire new ones.

This transition is not immediate. Initially, the companies placed themselves in the first part of the continuum by developing a product-oriented service (POS), offering the bottle of wine accompanied by small services, such as pre and post-sales consultancy and export abroad. At the same time, they are oriented towards the introduction of services: in fact, they are placed in the final part (Integration-oriented PSS (IOPSS)) (see Figure 2).

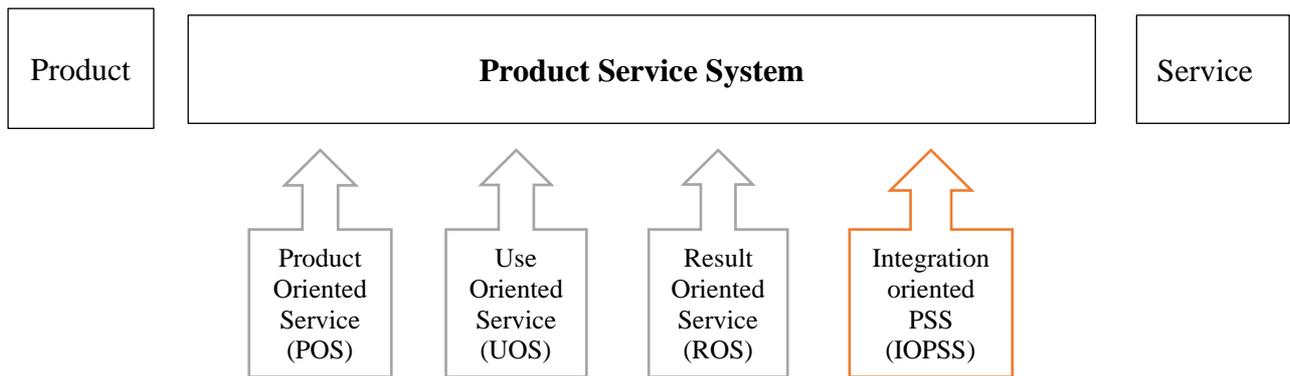


Fig. 2 Product-Service Continuum

From the interviews, it is clear that companies have unknowingly created Business Units that are essentially concerned with services. It can therefore be said that this is perfectly in line with the introduction methods promoted by Leoni (2015), who states that to have more than positive returns in SMEs, services must not be fully integrated within their offer to the public but creating a dedicated business unit could be a fruitful solution.

On the statements made so far, and with the need to answer the research question, we can reflect on the fact that most of the services offered required considerable efforts: changing the traditional way of selling by the winemaker, who previously carried out the simple sale of bulk wine in local wine shops, and over time there has been a completely unexpected change, where traditional channels are no longer available and collaboration with the external environment (customers, suppliers and universities in particular) becomes precious; everything is reinforced by the statement "we alone are not going anywhere, we need the support and help of all our stakeholders". It is precisely here that the need arises for a fruitful collaboration with external agents and therefore with universities, not having all the competencies and knowledge necessary to develop the services that will result in an offer of PSS.

All this, however, is not as easy as expected: the interviews show the desire to establish collaborations with universities, but often there are difficulties, such as the failure to continue the projects initiated

by the regional universities, or how sometimes the Calabretta lawyer claims, based on his experience, lack of funds for the development of some projects.

In the second analysis, it is stated that, in a certain sense, wineries recognize their limitations and, in some way, want to establish relationships with universities regarding the development of innovative practices in the field of services. Most of the companies interviewed carried out projects supported by both local and European universities, but they mainly concerned two areas, the organic sector and the wine sector, for example, to classify wine varieties, to experiment with new micro-vinification techniques, the mapping of the territory to increase knowledge of their vineyards; the other area concerned the development of environmental sustainability plans that do not only concern the managerial area in question, but concern reputational aspects and the construction and strengthening of its image in the reference market.

3.5 Discussions

Thanks to the results, it is stated that wine SMEs are unconsciously placed in the continuum of the implementation of servitization (Tukker, 2004), in two opposite positions: on the one hand, they carry out the supply of the bottle of wine, enhancing it with related services, such as transport, export abroad and pre and post-sales consultancy (POS) (Tischner and Verkuijl, 2002; Baines et al., 2007; Tukker, 2004; Neely, 2008); on the other hand, they have created business units (Leoni, 2015) dealing with hospitality, tasting and entertainment managed by experts in the sector (integrated orientation PSS) (Neely, 2008), then collaborations have been established with of suppliers.

In the considerations that emerged, universities play a marginal role in the development of services; instead, they have made a significant scientific contribution in completely different sectors, such as the environmental sector, preparing workers for the development of feasible environmental plans, and in the organic sector, studying new winemaking practices, introducing new genetically modified grape species, and many other contributions aimed at improving the quality of the wine more and more.

3.6 Conclusions

This study aims to verify the consistency between established concepts in literature and business reality, focusing on how wineries develop a PSS and on how the companies themselves establish relationships between universities and other external agents, as part of the introduction of PSS.

This in-depth analysis made it possible first of all to identify the reference services that wineries develop in their offer to the public, and subsequently facilitated the positioning of wine SMEs in the

implementation continuum of servitization (Tukker, 2004). Thanks to this positioning, the product-service continuum has been redesigned, which can encompass all the dimensions of the PSS.

Due to the complexity of introducing a PSS, profound changes in the business model, resources and competencies at all levels of the company are required within a company, as it is a global redesign of the traditional offering into a new offer, which includes all those basic and advanced services for an efficient PSS. All this radical change, in turn, generates the need to collect unknown information and knowledge within the cellars due to the different traditional concepts and mentality of producing and selling bottles of wine.

The university, being a huge cauldron containing the necessary competencies and knowledge, could, in the future, become one of the most popular allies.

The wineries have undertaken collaborative relationships with universities but, in contexts other than this field of study, areas that enhance the corporate reputation, the image of the same outside on the reference markets, especially in the environmental and biological fields. Therefore, the wineries for the development of services in their offer to the public did not make use of universities directly, but of external agents specialized in the catering, hospitality and entertainment sectors, due to lack of experience and expertise in the sector.

3.7 Limitations

The study carries within itself the limitations common to any qualitative analysis. In particular, it uses an exploratory analysis based on multiple case studies of a single region, so the results cannot be generalized to the entire population of wine producers. To extend the validity and generalizability of the results, other cases belonging to different regions should be examined and then compared. Subsequently, in order to be reliable, this study should be accompanied by quantitative analysis.

3.8 Practical implications

From the results illustrated above, theoretical and practical implications can be extrapolated which are very useful for managers operating in low-technology sectors. This study tried to reconceptualize the Product-Service continuum carried out by Neely 2008, integrating it with the latest approach of a PSS. Not aiming at exhaustiveness, additional studies on this direction are recommended. On a practical level, the will on the part of SMEs to expand borders is often not enough, so it is necessary to undertake fruitful collaborations with any external reference interlocutors, even if the relationship with universities, inherent in the development of innovative organizational practices, is very limited. Rather than trying to do anything on your own, it is more beneficial to undertake a focusing strategy,

to better organize existing internal knowledge and integrate it more consciously with what may come from the external environment.

3.9 References

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Chapter 4. Collaborations, Absorptive Capacity and Innovative Performance: A quantitative approach

4.1 Introduction

SMEs have a substantial influence on the economy of most countries (Agostini & Nosella, 2018; Wright et al., 2015). The importance of SMEs for economic growth has been recognized in the academic literature with attention to their strategic behavior (Robinson, Pearce, 1984), to their growth and development of various types of innovations (Gibb, Scott, 1985).

Since the 1980s it has been widely reiterated that SMEs are different from large firms in the way they operate and are managed (Welsh, White, 1981; Gibb, Scott, 1985; D'Amboise, Muldowney, 1988; Julien, 1993; Torres, 1997).

This claim is largely supported by recent findings in the literature, as they suggest that there is a difference between low-tech firms and their counterparts, high-tech firms (Reboud et al., 2014). This is particularly true concerning the number and type of innovations generated and how these companies manage their development process (Mazzarol and Reboud, 2011).

However, research findings show that low-tech SMEs can be active innovators despite their limited scale and resources (Raymond, St-Pierre, 2010).

In response to these challenges, innovation becomes a strategic option for this type of company (Rosenbusch, Brinckmann & Bausch, 2011).

In an era of increasingly globalized markets and production, the ability to innovate is increasingly important for business success (Belderbos et al., 2015; Camisón and Villar-López, 2012).

The factors that promote the innovativeness of manufacturing firms have been extensively discussed in the innovation literature (Von Tunzelmann and Acha, 2005). Among others, the possibility of acquiring and integrating external sources of knowledge, distributed across a large number of actors, has been recognized as one of the most relevant factors in open innovation (Chesbrough and Crowther, 2006; Spithoven et al., 2010).

Studies on small and medium-sized manufacturing enterprises (SME) suggest that innovation is a necessary prerequisite to keeping one's competitive performance as stable as possible (Liao, Rice, 2010).

However, due to the liability of smallness (Rogers, 2004), the literature shows that SMEs rely less on internal development to drive their innovation and more on external collaboration to overcome resource constraints and drive innovation (Classen et al., 2012).

What is important from both research and a policy perspective is that meaningful innovation can occur throughout the value chain and can involve collaboration with other parties. This is particularly

relevant for innovation processes in SMEs (Reboud et al., 2014). The ability of many SMEs to successfully engage in innovation and commercialization is often limited by lack of resources, weak or unsystematic marketing and management competencies, and inadequate use of appropriate third-party consultants (Adams, 1982; Vermeulen, 2005).

In detail, to access any type of knowledge, companies should improve their absorptive capacity, acquire external knowledge and establish suitable channels for its transmission; this internal improvement is not an easy step for SMEs to take (Muscio, 2007). To acquire new knowledge, companies need to know where and how to find it, and how to assimilate and disseminate it through their corporate structure (Muscio, 2007).

On these perspectives, companies intentionally develop networking competencies (Mitrega et al., 2017) (i.e., start, manage and/or terminate commercial relationships) to exploit their competitive advantage by achieving greater innovation performance (Freitag & Young, 2014). From this point of view, the accessibility of companies to new external sources of knowledge and their capacity for innovation depends on the strength of the collaborations established with external agents (Saeed Najafi-Tavani et al., 2018).

In this sense, SMEs need to establish collaborations, both vertically (customers, suppliers, and competitors), and horizontally (universities, research centers, sector experts) (Tsai, 2009; Saeed Najafi -Tavani et al., 2018).

Previous studies in the literature suggest that collaboration with suppliers and customers plays a different role than collaboration with universities and research institutes, as these two orientations provide access to different types of knowledge and resources for the development of a product, process, and innovation innovations. service (Chen et al. 2011; Rothaermel and Deeds 2004). Therefore, the mechanisms underlying the search for knowledge could influence not only the transfer of knowledge itself but also the development of AC and consequently the development of new innovative practices.

For this reason, the collaboration of companies with various external partners, both vertical and horizontal, broadens the range of internal knowledge and can support the development of new innovative practices.

However, to successfully access new knowledge through collaborations with the external environment, companies must develop the knowledge necessary to search, find, access and interpret for their use the information incorporated in external organizations (Forfás, 2005).

The subject of this study is the Italian wine SMEs, a striking example of the need to keep up with the times. Nowadays, the classic winery is not seen as it once was, where manufacturing was the fulcrum of corporate life, but now it is seen as the promoter of a local system of services that complete and

brighten the experience of wine lovers in the cellar. The winery not only sells bulk wine and therefore concentrates all its knowledge and strength in the creation of a good win but is making a transition towards the sale of a system of ancillary services that frame its bottle of wine in a context more appealing to its consumers.

Summarizing these concepts in a research question, we can say that this study aims to investigate the mediation role played by the collaboration of wine SMEs with external agents, becoming a driving force through which, the absorptive capacity allows SMEs to generate various types of innovation. The reference sample consists of Italian wine SMEs, which were subjected to a questionnaire for the collection of data to be analyzed through an empirical analysis of the Structural Equation Modeling (SEM) type.

4.2 Theoretical background

Previous studies increasingly highlight the importance of collaboration with different types of partners (e.g., suppliers, customers, competitors and universities/research organizations) in enabling companies to develop their innovative performance (Tsai, 2009; Saeed Najafi-Tavani et al., 2018). The increased complexity of knowledge processes, as a key driver of innovation, encourages companies to investigate and explore fruitful knowledge beyond their borders to strengthen their internal capabilities (Becker & Dietz, 2004; De Faria, Lima, & Santos, 2010). In this sense, the collaboration with different external actors improves both the sharing of knowledge and the acquisition of market knowledge by the company, with consequent expansion of the existing knowledge base within the organization, which in turn improves its capacity for innovation (Claus & Kesting, 2017; Freel, 2003; Luzzini et al., 2015; Zhou & Li, 2012).

In line with this perspective, some scholars argue that collaboration with external actors to develop new products, processes or services improves SMEs' accessibility to the scarce resources they may lack internally (Saeed Najafi-Tavani et al., 2018). One of these critical resources is knowledge (Grant, 1996) which is defined as "relevant information, actionable and based at least in part on experience" (OECD, 2005, p. 113). Knowledge can be explicit or tacit (Camison & Villar-Lopez, 2014; Nonaka, Takeuchi, & Umemoto, 1996); while the former is encoded, the latter is rooted in experiences, procedures, emotions and knowledge (Nonaka, Toyama, & Nagata, 2000), and therefore extremely difficult, if not impossible, to explain and exchange (Fayard et al., 2012).

Acquiring external knowledge and establishing adequate channels for its transmission are not simple processes (Muscio, 2007). To acquire new knowledge, companies need to know where and how to find it, and how to assimilate and disseminate it through their corporate structure (Muscio, 2007).

For this reason, the collaboration of companies with external partners broadens their range of competencies and can support the development of new innovative practices. However, to successfully access new knowledge through collaborations with the external environment, companies must develop the knowledge necessary to search, find, access and interpret for their use the information incorporated in external organizations (Forfás, 2005).

In detail, to access any type of knowledge, firms should improve their absorptive capacity, known in the literature as ACAP (Van den Bosch et al., 1999; Floyd and Lane, 2000; Zahra and George, 2002). ACAP, which refers to "an ability to recognize the value of new information, assimilate it and apply it for commercial purposes" (Cohen and Levinthal, 1990; p. 128), is a dynamic ability that appears particularly relevant in the development of innovations since one of the main obstacles in the effective and efficient implementation of entrepreneurial activities is the management of uncertain situations in which typically consolidated knowledge and information are lacking (Lumpkin and Dess, 1996). Zahra and George (2002) argue that the ACAP consists of several phases, such as the acquisition, assimilation, transformation and exploitation of external knowledge. Acquisition refers to the organization's ability to identify and acquire knowledge generated externally (e.g. customers, suppliers, competitors, research centers) (Todorova and Durisin, 2007). Knowledge assimilation routines allow the company to analyze, interpret and understand process information acquired from external sources. The factor that promotes the assimilation of knowledge is understanding (Zahra and George, 2002).

The transformation phase of the acquired and assimilated knowledge allows the company to combine this knowledge with an internal knowledge base by adding or eliminating those superfluous to the process.

Finally, exploitation is the ability to refine, develop and/or modify and then exploit existing knowledge internally mixed with assimilated and transformed acquired knowledge, incorporating them into the operational routines of the company (Zahra and George, 2002).

4.3 Research Hypotheses

To have a high degree of specialization and understanding of the phenomenon of mediation of the company's collaboration with the external environment, we follow two paths, one refers to the deepening of the relationship that explains the ACAP approach relating to the various types of innovation (process, product and service), reinforcing the literature which states that the knowledge necessary for the development of innovations varies according to the type of innovation that the company intends to develop (James, Leiblein and Lu, 2013); the second group of hypotheses, takes the path of exploring the role of mediation assumed by different types of Collaboration (vertical and

horizontal collaboration) that a company can establish to acquire, assimilate, transform and exploit external knowledge in order to develop a technological innovation (Process and Product) and service innovation.

Innovation can only happen if companies have an adequate set of capabilities to innovate (Laforet, 2011). Innovation is usually explained in terms of changes in what a company introduces to the market (product and service innovation) and the approaches it takes to create and deliver those offerings (process innovation) (Francis & Bessant, 2005; Liao, Fei, & Chen, 2007). Product innovation capacity reflects the ability of companies to introduce new products to meet market needs (Damanpour, 1991; Mitrega et al., 2017; Zaefarian et al., 2017), or to employ new technologies for commercial purposes (Lukas & Ferrell, 2000). Conversely, process innovation reflects the introduction of new inputs or processes (including materials, task specifications, workflow mechanisms and information and equipment) to the company's manufacturing operations, which are then employed to manufacture a product (Damanpour, 1991) and which consequently facilitates quality improvement and/or cost savings (Johne, 1999; Nasution et al., 2011). Instead, service innovation refers to "service offerings that directly or indirectly produce value for companies and their customers" (Salunke et al., 2019, p.147).

Product innovations and process innovations need special knowledge to be decoded (James, Leiblein and Lu, 2013), and therefore, take longer to develop (Damanpour and Gopalakrishnan, 2001) and are tacit and systematic (Terjesen and Patel, 2015). Due to the complex nature of the product and process innovation, technological capabilities are often required within a manufacturing SME to enable them to acquire, assimilate and exploit knowledge - often generated externally - to improve their products and production processes and operations (Cohen and Levinthal, 1990; Zahra and George, 2002).

Secondly, the services, having particular characteristics of intangibility and non-reproducibility, require, for their development, specific advanced information. Despite the importance of technologies, in general, for this purpose, other types of intangible knowledge (organizational, marketing, etc.) become relevant to better develop services in manufacturing SMEs (Coombs & Miles, 2000; Hipp & Grupp, 2005; Tether, 2005). For this different nature of the various types of innovation (product and process innovations are different from service innovation), in this study focused on the behavior of SMEs, we refer distinctly to Technological Innovations on the one hand (product and process), and on the other hand, we illustrate the innovations of services, since only in the low-tech sectors can the innovation of services be obtained even without the use of sophisticated technological knowledge (Reboud et al., 2014).

Due to the different nature of the various types of innovation that can be developed, the company needs knowledge inherent in each innovation process that is completely different from one another.

The various types of innovations involve resource-intensive research aimed at exploring new frontiers that are radically different from existing offerings to find new combinations of commercially exploitable technological knowledge (Laursen 2012; Rosenkopf and Nerkar 2001).

Since companies usually have limited internal resources available to promote innovations (technological and service innovations), they can use external collaboration to gain access to relevant knowledge located outside their borders (Ferreras-Méndez et al., 2019) or to find sources of variety that facilitate the creation and combination of new technologies and knowledge (Laursen & Salter, 2006).

Therefore, new models of innovation suggest that innovators do not only work alone (Rampersad, Quester & Troshani, 2010). Indeed, they interact with several institutions within and outside the system in which they operate (Belderbos, Carree & Lokshin, 2004).

Therefore, organizations have to work and tap into the knowledge of a multitude of actors, both inside and outside their organization (Katila and Ahuja 2002).

Thanks to these contributions from the literature, we expose the following research hypotheses:

H1a: Collaboration mediates the relationship between ACAP and Technological Innovations

H1b: Collaboration mediates the relationship between ACAP and Service Innovation

From the knowledge-based point of view (Grant, 1996, 1997; Nonaka, 1994), collaboration on innovation is associated with the acquisition of knowledge that is not present within the firm (Chesbrough, 2003; Grant and Baden-Fuller, 1995), e.g., information on customer requests, market needs or specialized technological knowledge (Belderbos et al., 2006; Tödting et al., 2009; Von Hippel, 1994). Collaboration thus extends the knowledge base available for the recombination of knowledge, which is a central engine of innovation (Conner and Prahalad, 1996; Sood and Tellis, 2005). Secondly, from an organizational learning perspective (Argote, 2013; Argote and Miron-Spektor, 2011; Fiol and Lyles, 1985), collaboration allows companies to learn knowledge and competencies related to the technological and market aspects underlying a product, process, and service innovation (Kogut and Zander, 1992; van Beers and Zand, 2014). Furthermore, according to the resource-based view (Barney, 1991; Wernerfelt, 1984), collaboration on innovation is a means of accessing the resources owned by partner organizations (Ahuja, 2000; Mowery et al., 1998; Wassmer and Dussauge, 2012) and the (monetary) risks associated with innovation in uncertain technological environments (Belderbos et al., 2004a; Das and Teng, 2000).

Based on these perspectives, companies intentionally develop networking knowledge (Mitrega et al., 2017) (i.e., start, manage and/or terminate commercial relationships) to exploit their competitive advantage by achieving greater innovation performance (Freytag & Young, 2014). From this point of view, the accessibility of companies to new external sources of knowledge and their capacity for

innovation depends on the strength of the collaborations established with external agents (Saeed Najafi-Tavani et al., 2018).

As discussed so far, collaborations with external partners can increase the accessibility of companies to the knowledge resources of different actors in the external environment (Faems, Van Looy, & Debackere, 2005; Yan & Dooley, 2014). However, the benefits of creating fruitful partnerships can only be realized when a firm has a high level of absorptive capacity (Tzokas et al., 2015). In other words, a sufficient degree of absorptive capacity is required for effective learning in a business collaboration agreement (Lane, Salk, & Lyles, 2001; Tsai, 2009). Having a strong absorptive capacity allows companies to identify, communicate and scan/assimilate the knowledge resources of partners. It has been argued that absorptive capacity increases firms' sensitivity to knowledge resources existing in the external environment (Winkelbach and Walter, 2015; Zahra and George, 2002). It also helps companies to use (Chen et al., 2009), develop and reconfigure acquired external knowledge (Eisenhardt & Martin, 2000). Consequently, when the level of absorptive capacity is high, a company is in a better position to scan and use external knowledge (Tzokas, et al., 2015) acquired through collaborations that allow the development of product innovations, of process and service (Saeed Najafi-Tavani et al., 2018).

Previous studies in the literature suggest that collaboration with suppliers and customers plays a different role than collaboration with universities and research institutes, as these two arguments provide access to different types of knowledge and resources for the development of product, process and service innovation (Chen et al. 2011; Rothaermel and Deeds 2004). Therefore, knowledge-seeking mechanisms could influence the knowledge transfer and development of AC.

Previous literature studies on alliances suggest that vertical collaboration plays a different role than collaboration with universities and (horizontal) research institutes, as these two orientations provide access to different types of knowledge and resources (Chen et al. 2011; Rothaermel and Deeds 2004). For example, the nature and type of knowledge required by one of the collaborating firms can also influence the transfer of knowledge, in particular, through the type of mechanism required for its transfer (Murovec and Prodan 2009).

Thanks to these theoretical contributions, we refer to two types of collaboration, vertical and horizontal, also in line with other theoretical contributions that have dealt with these issues in parallel (Ahn et al., 2017; Miemczyk, 2008; Parida et al., 2012; Reniers et al., 2010).

In detail, Vertical Collaboration refers to customers, suppliers, vendors, resellers and other market entities, which allow conducting knowledge research to meet market needs and improve the timeliness of innovative business performance (Wu and Wang, 2018). Interaction with agents within

the sector allows companies to increase their knowledge of the market in which they operate and improve their ability to market their products and services (Jraisat et al. 2013).

When an SME develops innovative customer-centric solutions, this perceived value can improve long-term collaborative relationships with customers, reducing the customer's intention to find their way elsewhere (Day, 2000; Salunke et al., 2019).

In this sense, companies that support partnerships for innovation with customers and suppliers may be able to increase the speed with which they discover new opportunities and respond to technological and market changes by expanding and renewing their knowledge base (Hsieh and Tsai 2007; Lane et al. 2006; Tzokas et al. 2015). Accumulation of new knowledge not only increases firms' exploratory learning process but also their ability to engage in the transformation process through the evaluation, use and implementation of new knowledge (Zahra and George 2002). Furthermore, as companies accumulate more knowledge and experience, they become more efficient in applying their knowledge base and thus generate more exploitable activities due to the self-reinforcing nature of learning (Zhou and Wu 2010).

Under these considerations, we carry out the following research hypotheses:

H2a: Vertical Collaboration mediates the relationship between ACAP and Technological Innovations

H2b: Vertical Collaboration mediates the relationship between ACAP and Service Innovation

Instead, horizontal collaboration refers to the collaboration between universities, research centers, sector consultants, public and private research companies (Paula et al., 2019).

Improving the accessibility of companies to complementary resources, facilitating the exchange of tacit and explicit knowledge and reducing the risk of research and development activities by distributing the associated costs on different channel partners are among the main advantages of horizontal collaborations (Faems et al., 2005; Yan & Dooley, 2014).

Universities are a valuable source of research results for companies in many sectors and this importance has grown over time (Narin et al., 1997). Several researchers have described the industrial use of university-based scientific research in the development of new products, processes and services (Cohen et al., 2002; Mansfield, 1991,1995; Mansfield and Lee, 1996; Mansfield, 1998; Grossman et al., 2001; McMillan et al., 2000; Narin and Olivastro, 1992; Cockburn and Henderson, 2001).

On the other hand, collaboration with research centers or consulting institutes can help SMEs to build or improve their ACAP (Ferrerias-Méndez et al., 2019). SMEs operating in traditional industries and lacking the resources and capabilities to transform available external knowledge into innovative products and services can seek collaborations with technology intermediaries or research centers to develop ACAP externally (Ferrerias-Méndez et al., 2019).

Additionally, strong partnerships with a blend of public and private institutions such as trade unions, governments, international development agencies, innovation centers, business incubators, professional support associations and research institutes enable SMEs to overcome the socio-cultural and resource barriers that they prevent them from identifying and exploiting international business opportunities in foreign markets (Szyliowicz and Galvin 2010).

Taking into consideration these focal points of horizontal collaboration research, we develop the following hypotheses:

H3a: Horizontal Collaboration mediates the relationship between ACAP and Technological Innovations

H3b: Horizontal Collaboration mediates the relationship between ACAP and Service Innovation

Below, we illustrate in detail our reference model that will allow us to analyze and test our research hypotheses:

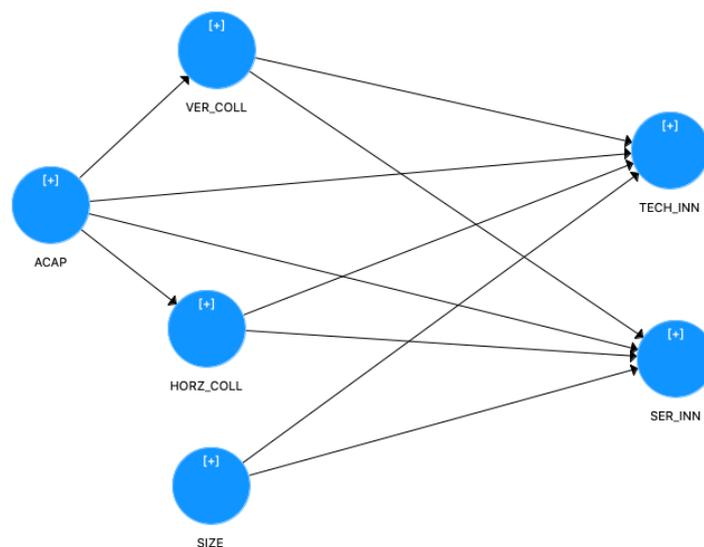


Figure 1: Explanation model

4.4 Methodology

4.4.1 Sample and data collection

The sample of companies examined refers to SME wineries in Italy. The extraction of the sample was carried out in the AIDA database, by entering the following ATECO codes: 0121 and 1102, referring to the wineries that cultivate and produce grapes, and therefore wine.

To further refine the research, reference was made to the European definition of small and medium-sized enterprises (SMEs). Art. 2 2003/361/EC defines the quantitative parameters for the

identification of SMEs: companies that have fewer than 250 employees, that do not exceed an annual turnover of 50 million euros and that do not exceed a total annual activity of 43 million euros.

In the end, a sample of 848 wine SMEs was identified. Thanks to the Qualtrics software, we have developed a questionnaire including all the topics useful for this empirical research: on product, process and service innovations, on how they have been developed, on the type of collaborations established with all external stakeholders (suppliers, customers, research centers, etc.). To investigate the validity and clarity of the issues touched in the questionnaire, we conducted a pilot study on 10 wine SMEs belonging to the 848 companies in the sample. Once the validation phase was completed, we submitted the questionnaire to all the wine SMEs in the sample. In conclusion of the response process of the wine SMEs, the final respondents were 112.

4.4.2 Context of analysis

In a context highly influenced by competitive forces and exposed to a constantly evolving environment, innovation has become one of the key factors for the resilience and performance of wineries, especially for old-fashioned European ones (Giuliani et al., 2011; Mariani et al., 2012).

The wine industry is characterized worldwide by localization in certain areas and the companies are mostly SMEs (Morrison and Rabellotti, 2017). Especially in the mature European context (eg Italy, Spain, France, Germany), the wineries are for the most part family businesses, related to the territory. On the contrary, new wine markets such as Australia, New Zealand, South Africa, Argentina, Chile and the United States are structured and well-organized players in the global scenario challenging the dominance of European producers (Anderson and Pinilla, 2018).

The Italian wine sector is an old traditional system characterized by thousands of SMEs consolidated over time, reflecting the work of generations. Italy is the second-largest wine producer in the world and the first exporter. The constant decrease in the consumption of domestic wine has forced wineries to open up to international markets. In such a context, innovation processes are essential to grow and earn, but the national system is still polarized between winemakers adhering to a traditional local market (i.e., low-tech) and those who look to global markets (i.e., high-tech), which are counted in the fingers of the hands (Giuliani et al. 2011; Mariani et al. 2012; Alonso Ugaglia et al. 2019a).

Recent market conditions and the need for renewal in such a traditional and conservative sector have increased the attention of managerial and business studies (Orth et al., 2007), particularly concerning entrepreneurship (Brown and Butler, 1995; Delacroix and Solt, 1987; Zhao, 2005), International Entrepreneurship (Lamb et al., 2011; Mariani et al., 2012), Strategic Management (Atkin et al., 2012; Porter and Bond, 1999), International Business (Kidwell and Fish, 2007) and Innovation Management (Aylward and Glynn, 2006; Dressler, 2013; Sánchez-Hernández et al., 2010).

4.4.3 Measures

The variables used in this study are as follows:

- The independent variable consists of the Absorptive Capacity (ACAP) obtained from a 7-point Likert scale (from completely disagree to completely agree). This construct is composed of 13 items, which reflect the aspects characterizing all the dimensions of the ACAP (acquisition, assimilation, transformation and exploitation). The variable was extrapolated from the work of Flatten et al. (2011).
- One of the dependent variables reflects Technological Innovations (TECH_INN). This construct is dichotomous and describes the introduction or not of product and process innovations that are new to the market or new to the company; this variable is made up of 3 items two inherent to product innovations (new products for the market, new products for the company), the other item reflects process innovations (the introduction of at least one process innovation). The source from which we have drawn this variable is the Community Innovation Survey 2014 (CIS).
- The other dependent variable is that of Service Innovation (SERV_INN). It too is a dichotomous variable that reflects the introduction or otherwise of the introduction of services in the company or in the market. It consists of 2 items, one relating to new services for the market and the other highlighting new services for the company. The source from which we have drawn this variable is the CIS 2014.
- The other dependent variable is the one that encompasses all innovations (INN), therefore it consists of 5 items (Technological innovations and service innovations. The source from which we have drawn this variable is CIS 2014.
- As a mediation variable we used the Vertical Collaboration (VER_COLL), obtained through a 7-point Likert scale (not used, widely used). This mediation construct is characterized by 3 items relating to Suppliers, Customers / Consumers and Competitors. This construct was extrapolated from CIS 2004.
- The other mediation variable is the Horizontal Collaboration (HOR_COLL), also obtained from a 7-point Likert scale (not used, widely used). This construct consists of 5 items, which include Consultants / Experts, R&D, Universities, Public Research Organizations and Private Research Organizations. This construct was extrapolated from CIS 2004.
- As a control variable (SIZE) we used an index that expresses the size of the SME, that is, the number of employees employed in the company.

Table 1 shows the variables in greater detail:

VARIABLES	DEFINITION	N° ITEMS	SOURCE
ACAP	Absorptive Capacity	ACAP1: search of information in the sector	Flatten et al., 2011
		ACAP2: management expects employees to deal with outside information	
		ACAP3: ideas and concepts are exchanged within the company	
		ACAP4: interdepartmental support to solve problems	
		ACAP5: rapid internal flow of information	
		ACAP6: periodic meetings for the exchange of information	
		ACAP7: employees use the knowledge gathered	
		ACAP8: employees absorb and apply new knowledge	
		ACAP9: employees combine existing knowledge with new one.	
		ACAP10: employees apply the new knowledge in their work	
		ACAP11: management supports the development of prototypes	
		ACAP12: the company reconsiders technologies and adapts them based on new knowledge	
		ACAP13: the company adopts new effective technologies	
TECH_INN	Technological Innovation	PR1: new products for the market	CIS (2014)
		PR2: new products for the company	
		PS1: introduction of a process innovation	
SERV_INN	Service Innovation	SE1: new services for the market	CIS (2014)
		SE2: new services for the company	
INN	Innovation	PR1: new products for the market	CIS (2014)
		PR2: new products for the company	
		PS1: introduction of a process innovation	
		SE1: new services for the market	
		SE2: new services for the company	
VER_COLL	Vertical Collaboration	VER1: suppliers	CIS (2004)
		VER2: customers and consumers	

		VER3: competitors	
HOR_COLL	Horizontal Collaboration	HOR1: consultants / experts	CIS (2004)
		HOR2: R&D	
		HOR3: university	
		HOR4: public research organizations	
		HOR5: private research organizations	
SIZE	Company dimension	Number of employees	Flatten et al., 2011

Table 1. Variables Explanation

4.4.4 Method

The approach used to test our hypotheses is the Partial Least Squares (PLS), a variance-based structural equation modeling technique (Roldán and Sánchez-Franco, 2012). The PLS allows at the same time to evaluate the reliability and validity of the measurements of the theoretical constructs (external model) and the estimation of the relationships between these constructs (internal model) (Barroso et al., 2010). According to Lowry and Gaskin (2014, p. 127), SEM is used to "model multiple independent and multiple dependent variables, chains of causal and indirect effects". Furthermore, Hair et al. (2014) explained that PLS-SEM can be adopted with non-normal data and small sample sizes. Reinartz et al. (2009) further state that the PLS should be applied when the number of observations is less than 250. Therefore, the hypotheses of SEM were satisfied in this study, having 112 observations. The measurement model and the structural model of the SEMs were evaluated with SmartPLS (v 3.3.3.). The reflective measurement model is used to examine internal consistency, convergent validity, and discriminant validity, while the determination coefficients and path coefficients were evaluated in the structural model.

4.5 Results

To get some more in-depth results to explain the phenomenon under consideration and then test the hypotheses made previously, we first refer to a simple model, which groups the two types of collaboration into a single construct of mediation, an attempt is also made to group all types of innovation into a single dependent variable; subsequently, we illustrate a more complex model that sees the collaboration split into vertical and horizontal, and the innovations divided into technological and service innovations.

Our model evaluation consists of two stages. First, we evaluate the measurement model, or external model, which links the manifest variables to their latent variables. Second, we test the structural model, which reveals the relationships between latent variables (Fornell and Larker, 1981; Hulland, 1999).

4.5.1 Simple Model

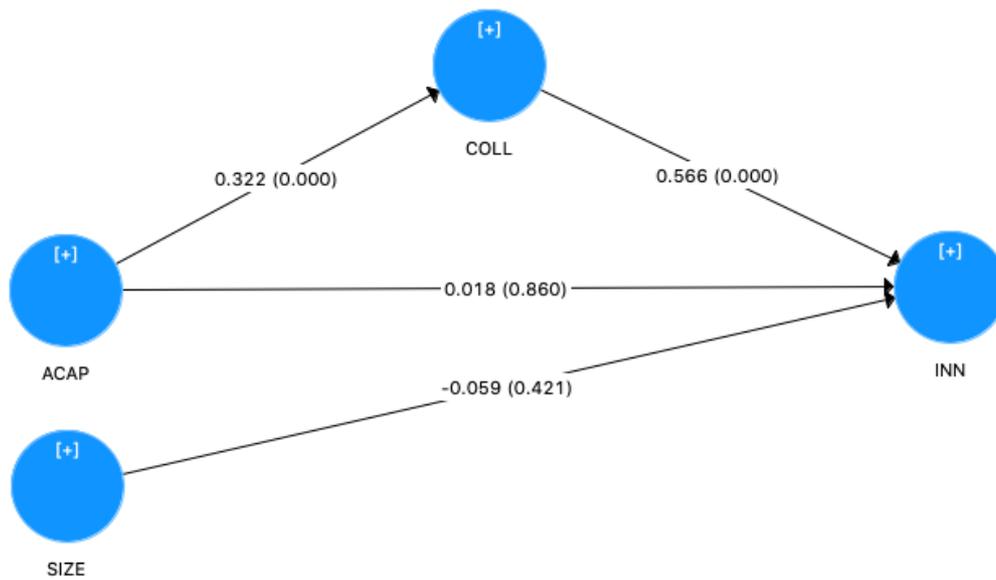


Fig. 2 Simple Model1

Fig. 2 shows the reference model of our analysis.

As explained above, we illustrate the results related to the Confirmatory Factor Analysis (CFA) to analyze the validity of the constructs making up the model.

		COMPOSITE RELIABILITY	Cronbach's alpha	LOADINGS	AVE	P-value
ACAP	ACAP1	0.970	0.966	(0.802)	0.715	0.000
	ACAP2			(0.586)		0.000
	ACAP3			(0.805)		0.000
	ACAP4			(0.850)		0.000
	ACAP5			(0.871)		0.000
	ACAP6			(0.838)		0.000
	ACAP7			(0.889)		0.000
	ACAP8			(0.888)		0.000
	ACAP9			(0.899)		0.000
	ACAP10			(0.898)		0.000
	ACAP11			(0.838)		0.000
	ACAP12			(0.889)		0.000
	ACAP13			(0.889)		0.000
COLL	COLL1	0.886	0.854	(0.551)	0.495	0.000
	COLL2			(0.750)		0.000
	COLL3			(0.716)		0.000
	COLL4			(0.748)		0.000
	COLL5			(0.736)		0.000
	COLL6			(0.715)		0.000
	COLL7			(0.714)		0.000
	COLL8			(0.680)		0.000
INN	PRO_INN1	0.704	0.507	(0.622)	0.328	0.000

	PRO_INN2			(0.603)		0.000
	PROC_INN			(0.683)		0.000
	SER_INN1			(0.468)		0.002
	SER_INN2			(0.453)		0.006
SIZE	EMPLOYEE	1.000	1.000	1.000	1.000	-

Table 2. CFA Results (Simple Model1)

For the reliability of the structure, Hair et al. (2016) recommend relying on the composite reliability score in PLS-SEM research, although Cronbach's alpha is a more common measure of internal consistency. Unlike Cronbach's alpha, however, composite reliability does not assume that all indicators are equally reliable. Furthermore, Cronbach's alpha is sensitive to the number of elements in the scale (Hair et al., 2011, 2016). First, composite reliability can be satisfied when it is greater than the acceptable threshold value of 0.7 (Nunnally and Bernstein, 1994, Hair et al., 2016). As can be seen from the table, all the constructs satisfy this statement. However, looking at Cronbach's alpha, the same cannot be said: the construct of Innovative Performance (INN) is not in line with what was stated above.

To examine the convergent validity, both the external loads of the indicators and the extracted mean-variance (AVE) were evaluated (Bagozzi and Yi, 1988; Hair et al., 2016).

Indicators with an external load of less than 0.4 must be removed from the scale (Hair, Ringle & Sarstedt, 2011). In this case, all the weights related to the items of the constructs are greater than 0.40. Secondly, according to Fornell and Larcker (1981), the acceptable AVE is 0.5. In this example, the AVEs of two constructs (COLL, INN) do not reflect this threshold. Consequently, convergent validity cannot be proclaimed in this study.

We can say differently for the discriminating validity. For this measure, reference is made to the correlations between latent variables and errors (see appendix): in this case in the diagonal, the square roots of the AVE are in all cases greater than the off-diagonal elements in the corresponding row and column (Fornell and Larcker, 1981; Capelli et al., 2016). Discriminant validity was supported in this research.

In addition, to strengthen the discriminating validity we have included the Heterotrait-Monotrait Ratio (HTMT). According to this criterion, in a well-fitting model, the heterotrait correlations should be lower than the monotrait correlations, which means that the HTMT ratio should be lower than 0.9 (Ferrerias-Méndez et al., 2019). From the results (Table 4, Appendix) the discriminant validity can be confirmed.

As far as the structural model is concerned, in Figure 2 the Path coefficients relating to the various relationships with the respective levels of significance have been presented, and in Table 5, the result of the mediation is presented to respond to the hypotheses made previously.

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics	P Values
ACAP -> COLL -> INN	0.182	0.197	0.051	3.590	0.000

Table 5. Mediation Effects (Simple Model1)

From what can be seen from the results obtained, we can say that Collaboration totally mediates the relationship between ACAP and innovative performance, since the direct relationship between ACAP and innovative performance is not significant (P-value 0.859).

At this point, for a correct validity of the model, we ask ourselves but does this mediating role assumed by the Collaboration with external agents apply to both Technological Innovations and Service Innovation? This question will allow us to answer the hypotheses H1a and H1b.

So, in this case, we do not refer to the single dependent variable that grouped all types of innovations, but we build ad hoc variables, one for Technological Innovations (TECH_INN) and the other for Service Innovation (SER_INN).

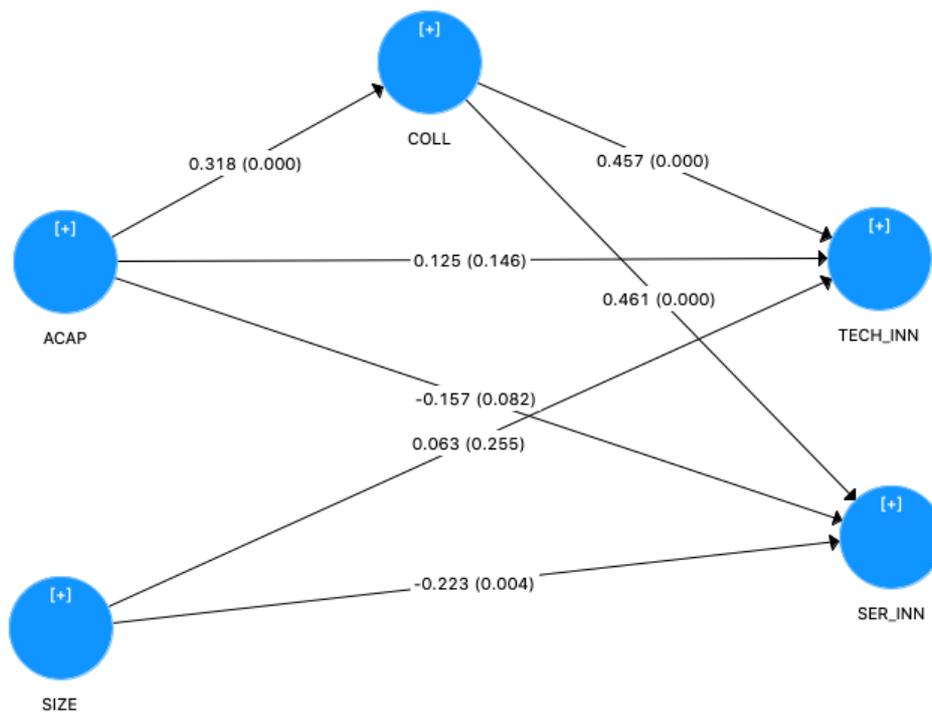


Figure 3. Simple Model2

Figure 3 shows the results of the SEM study. Below we will report the CFA only of the constructs that have been modified, for the remaining we take into consideration the values of table 1.

		COMPOSITE RELIABILITY	Cronbach's alpha	LOADINGS	AVE	P-value
TECH_INN	PRO_INN1	0.714	0.407	(0.645)	0.456	0.000
	PRO_INN2			(0.646)		0.000
	PROC_INN			(0.730)		0.000
SER_INN	SER_INN1	0.757	0.361	(0.815)	0.609	0.000

	SER_INN2			(0.745)		0.000
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Table 6. CFA Results (Simple Model2)

Regarding the reliability of the Simple Model2 structure, the composite reliability must be greater than the acceptable threshold value of 0.7 (Nunnally and Bernstein, 1994, Hair et al., 2016), so all constructs satisfy this statement. However, looking at Cronbach's alpha, the same cannot be said: the constructs of Innovative Performance (TECH_INN, SER_INN) are not in line with what was stated above.

To examine the convergent validity, both the external loads of the indicators and the extracted mean-variance (AVE) were evaluated (Bagozzi and Yi, 1988; Hair et al., 2016).

Indicators with an external load of less than 0.4 must be removed from the scale (Hair, Ringle & Sarstedt, 2011). In this case, all the weights related to the items of the constructs are greater than 0.40. Secondly, the acceptable AVE is 0.5. In this example, the AVEs of two constructs (COLL, TECH_INN) do not reflect this threshold. Consequently, convergent validity cannot be proclaimed in this study.

We can say differently for the discriminating validity. For this measure, reference is made to the correlations between latent variables and errors (see appendix): in this case in the diagonal, the square roots of the AVE are in all cases greater than the off-diagonal elements in the corresponding row and column (Fornell and Larker, 1981; Capelli et al., 2016). Discriminant validity was supported in this research.

In addition, to strengthen the discriminating validity we have included the Heterotrait-Monotrait Ratio (HTMT). According to this criterion, in a well-fitting model, the heterotrait correlations should be lower than the monotrait correlations, which means that the HTMT ratio should be lower than 0.9 (Ferrerias-Méndez et al., 2019). From the results (Table 8, Appendix) the discriminant validity can be confirmed.

As far as the structural model is concerned, in Figure 3 the Path coefficients relating to the various relationships with the respective levels of significance have been presented, and in Table 9, the result of the mediation to respond to the H1a and H1b hypotheses is presented.

	Original Sample (O)	Sample Mean (M)	Standard Deviation	T Statistics	P Values
ACAP -> COLL -> SER_INN	0.146	0.156	0.047	3.106	0.002
ACAP -> COLL -> TECH_INN	0.145	0.152	0.045	3.232	0.001

Table 9. Mediation Effects (Simple Model2)

From what can be deduced from the results obtained, we can affirm that Collaboration totally mediates both the relationship between ACAP and technological innovations and the relationship

between ACAP and Service Innovation, as the direct relationship between ACAP and innovative performances they are not significant (P-value 0.082 - 0.146). For these reasons, the H1a and H1b hypotheses are fully supported.

4.5.2 Complex Model

To finalize our analyzes, we now refer to a complex model in which we have highlighted all the specific relationships that may exist between the constructs.

Figure 4 shows the results of the SEM study. Below we will report the CFA related to this type of model.

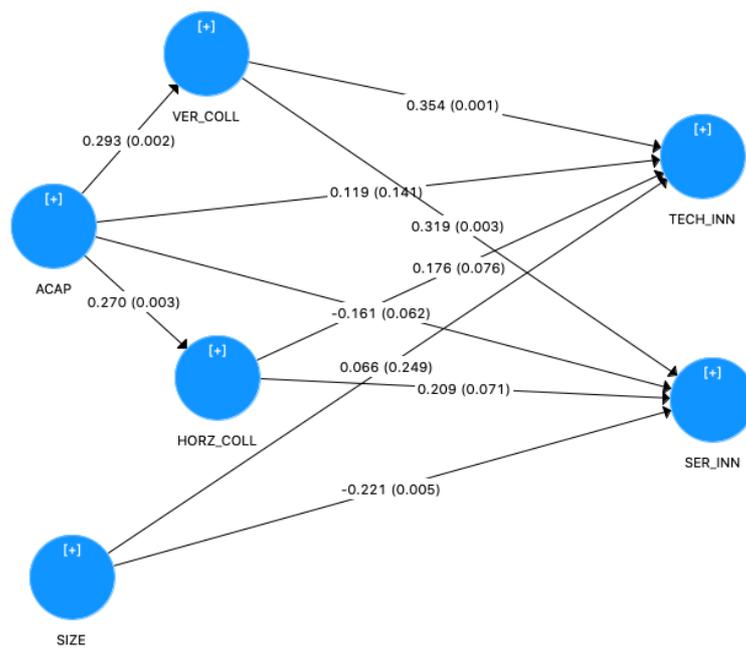


Figure 4. Complex Model

		COMPOSITE RELIABILITY	Cronbach's alpha	LOADINGS	AVE	P-value
ACAP	ACAP1	0.970	0.966	(0.801)	0.715	0.000
	ACAP2			(0.593)		0.000
	ACAP3			(0.810)		0.000
	ACAP4			(0.854)		0.000
	ACAP5			(0.871)		0.000
	ACAP6			(0.837)		0.000
	ACAP7			(0.889)		0.000
	ACAP8			(0.886)		0.000
	ACAP9			(0.898)		0.000
	ACAP10			(0.897)		0.000
	ACAP11			(0.835)		0.000
	ACAP12			(0.885)		0.000
	ACAP13			(0.890)		0.000
HORZ_COLL	COLL1	0.885	0.834	(0.559)	0.612	0.000
	COLL2			(0.815)		0.000

	COLL3			(0.805)		0.000
	COLL4			(0.874)		0.000
	COLL5			(0.819)		0.000
VER_COLL	COLL6	0.868	0.777	(0.796)	0.687	0.000
	COLL7			(0.860)		0.000
	COLL8			(0.830)		0.000
TECH_INN	PRO_INN1	0.714	0.407	(0.643)	0.455	0.000
	PRO_INN2			(0.651)		0.000
	PROC_INN			(0.727)		0.000
SER_INN	SER_INN1	0.756	0.361	(0.830)	0.609	0.000
	SER_INN2			(0.727)		0.000
SIZE	EMPLOYEE	1.000	1.000	(1.000)	1.000	-

Table 10. CFA Results (Complex Model)

Regarding the reliability of the Complex Model structure, the composite reliability must be greater than the acceptable threshold value of 0.7 (Nunnally and Bernstein, 1994, Hair et al., 2016), so all constructs satisfy this statement. However, looking at Cronbach's alpha, the same cannot be said: the constructs of Innovative Performance (TECH_INN, SER_INN) are not in line with the acceptable value of Cronbach's alpha (> 0.70).

To examine the convergent validity, both the external loads of the indicators and the extracted mean-variance (AVE) were evaluated, as previously done for the other models (Bagozzi and Yi, 1988; Hair et al., 2016).

Indicators with an external load of less than 0.4 must be removed from the scale (Hair, Ringle & Sarstedt, 2011). In this case, all the weights related to the items of the constructs are greater than 0.40, so we do not get to the elimination step.

Secondly, the acceptable AVE is 0.5. In this example, only the AVE of the TECH_INN construct does not reflect this threshold. Consequently, convergent validity cannot be proclaimed in this study. We can say differently for the discriminating validity. For this measure, reference is made to the correlations between latent variables and errors (see appendix): in this case in the diagonal, the square roots of the AVE are in all cases greater than the off-diagonal elements in the corresponding row and column (Fornell and Larcker, 1981; Capelli et al., 2016). Discriminant validity was supported in this research.

In addition, to strengthen the discriminating validity we have included the Heterotrait-Monotrait Ratio (HTMT). According to this criterion, in a well-fitting model, the heterotrait correlations should be lower than the monotrait correlations, which means that the HTMT ratio should be lower than 0.9 (Ferreras-Méndez et al., 2019). From the results (Table 12, Appendix) the discriminant validity can be confirmed.

As regards the structural model, in Figure 3 the Path coefficients relating to the various relationships with the respective levels of significance have been presented, and in Table 13, the result of mediation is presented to respond to the last block of hypotheses.

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (O/STDEV)	P Values
ACAP -> VER_COLL -> SER_INN	0.092	0.094	0.045	2.038	0.042
ACAP -> VER_COLL -> TECH_INN	0.103	0.108	0.043	2.383	0.018
ACAP -> HORZ_COLL -> TECH_INN	0.047	0.052	0.034	1.377	0.169
ACAP -> HORZ_COLL -> SER_INN	0.058	0.064	0.037	1.556	0.120

Table 13. Mediation Effects (Complex Model)

Going to specify both Collaboration (Vertical and Horizontal) and Innovative Performances (view Fig.5), we can affirm that the H2a and H2b hypotheses are supported, highlighting a total mediation of Vertical Collaboration (Customers, Competitors and Suppliers), between ACAP and Innovative Performances, both Technological Innovations and Service Innovation. This could reflect the type and degree of collaboration that is established between a company and market agents (Customers, Competitors, Suppliers). Instead, we can say differently for the hypotheses H3a and H3b which do not register any type of mediation relationship of the variables inherent to the Horizontal Collaboration.

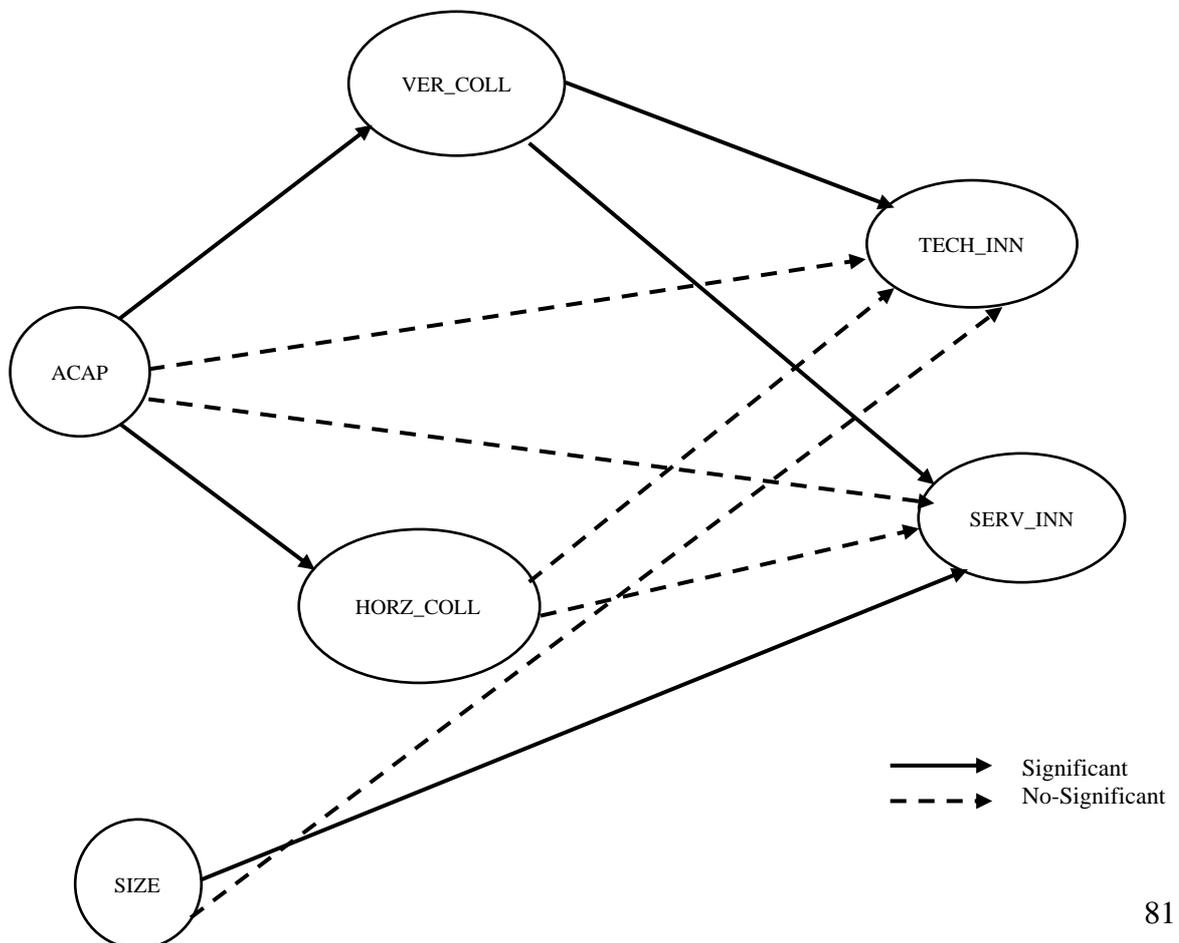


Figure. 5 Significance of the model

4.6 Discussions and Conclusions

It is now well accepted that establishing and sustaining a competitive advantage depends on the effective development of internal knowledge, the use of external knowledge, and the exploitation of knowledge to generate innovations (Kogut and Zander, 1992; Teece, 1996).

The development of the firm's ability to access external sources of knowledge is not limited to activities that take place strictly within an SME. As pointed out by Cockburn and Henderson (1998) and Zucker et al. (1994, 1998), "collaboration" with external knowledge sources offer advantages in terms of accessing and exploiting external knowledge. Some scholars have argued that collaborating with external actors to develop technological or service innovations improves the accessibility of manufacturing SMEs to the scarce resources they may lack internally (Saeed Najafi-Tavani et al., 2018). This is confirmed by the importance of the mediation role assumed by the external Collaboration, in the acquisition, transformation, and enhancement of external knowledge for the development of technological innovations (Product and Process Innovations) and services. Therefore, even based on an examination of the literature, we can say that the hypotheses H1a and H1b are fully supported.

Given the importance of collaborations, moving to the acquisition of external knowledge and establishing adequate channels for their transmission are not easy processes (Muscio, 2007). To acquire new knowledge, SMEs need the know-how and above all where to find it, and how to assimilate and disseminate it through their company structure (Muscio, 2007). SMEs, due to their small size, their scarcity of internal resources, and the socio-cultural barriers that employees, and not only, may have, have various difficulties, and face differently the problem of establishing collaborations with various partners, both from the sector in which they operate and from outside (e.g. universities and research centers).

Therefore, in the first analysis, we can affirm that the knowledge necessary for the development of innovations varies according to the type of innovation that the SME intends to develop within the organization, in line with the literature (Francis & Bessant, 2005; Liao, Fei and Chen, 2007).

Technological innovations require special knowledge to be decoded (James, Leiblein, and Lu, 2013) and therefore take longer to develop (Damanpour and Gopalakrishnan, 2001) and are tacit and systematic (Terjesen and Patel, 2015).

Services, on the other hand, having particular characteristics of intangibility and non-reproducibility, require, for their development, advanced and non-technological information, not comparable to the

knowledge required by product and process innovations (Coombs & Miles, 2000; Hipp & Grupp, 2005; Tether, 2005).

These statements extrapolated from the literature make us reflect on the fact that SMEs, which need different knowledge to develop different innovations, will need to establish different fruitful relationships to capture these different sources of knowledge. Our reflection is in line with the literature, as the Vertical Collaboration of SMEs with suppliers, customers and competitors plays a different role than the Horizontal Collaboration with Universities and Research Institutes, as these two orientations provide access to different types of knowledge. and resources for the development of the product, process, and service innovations (Chen et al. 2011; Rothaermel and Deeds 2004).

Thanks to our analysis we can affirm that the hypotheses H3a and H3b have not been supported due to the nature of the Collaboration, referred to the horizontal Collaboration, as the relationships that can be established with the Universities will be difficult to implement in the wine SMEs, being companies operating in a purely low-tech manufacturing sector.

This can be reinforced by the fact that low-tech SMEs have a lot of difficulty in finding a common language with research institutes and experts, due to the poor competencies and knowledge of their employees (Reboud et al., 2014), especially when talking about technological innovations, these claims, given the results, can also be extended when it comes to developing a service.

In fact, for the latter type of innovation, this result is counterintuitive, compared to Technological Innovations. To be developed, as we said previously, the services require knowledge relating to market research, marketing studies, but also organizational insights; substantially given the lack of relationship between horizontal collaboration and innovations, we can say that these are developed without the external help of other partners, in this case, universities and research centers.

For an SME, on the other hand, the interaction with the agents of their sector (suppliers, customers, and competitors) allows them to increase their knowledge of the market in which they operate and improve their ability to market their products and services (Jraisat et al., 2013). When an SMB develops innovative customer-centric solutions, this perceived value can improve long-term collaborative relationships with customers, reducing the customer's intention to move elsewhere. The support of the latest hypotheses (H2a and H2b) reinforces the reflections made previously because they refer to vertical collaborations between the company and customers, competitors, and suppliers. Despite the request for different information depending on the type of innovation to be developed rooted within it, a low-tech manufacturing SME could be more facilitated in establishing this type of collaboration thanks to the direct connection with partners in the sector. Furthermore, we believe that, despite the key role that collaboration with market players can play, its final impact may depend on the level of absorptive capacity possessed by the company itself.

Therefore, based on these results, we can affirm that the evidence emerged both in the literature and in our results, inherent to Technological Innovations, can also be extended to the realization of Service Innovations, to develop within a technological manufacturing SME and service innovations, the company itself must aim for a high ACAP, which will bring a greater understanding of external knowledge and therefore an increasingly important development of Vertical Collaborations.

With time and with the exploration of manufacturing SMEs in the world of innovations in general, even Horizontal Collaborations could be considered strategic collaborations that would make a difference in an ever-changing world.

With these final considerations made, this study reflects theoretical contributions. First of all, in this study, the two types of collaborations are treated separately, on the one hand, the sector collaborations (Vertical) with competitors, suppliers, and customers, on the other hand, the Horizontal Collaborations with research centers, universities, and experts in the sector; usually in the literature in the works that explore the role of collaborations there is a tendency to generalize this type of variable. Secondly, we affirm that, based on the results presented, only Vertical Collaboration plays an important role in an SME with a high ACAP that intends to develop both a Technological Innovation and a Service Innovation, even though in the literature it has always been stated that the establishment collaborations with universities and research centers could be a fruitful opportunity for the development of innovations in manufacturing SMEs.

Additionally, our findings provide some insight into managerial practice. First, they emphasize that it is important for managers operating in the market to draw knowledge from external sources in order to develop any type of innovation. Secondly, our study provides evidence that the acquisition and understanding of external knowledge are necessary, but not sufficient, for the development of process-related innovation activities, there is a need to establish collaborations with external agents inherent to the market. in which the reference company operates. Companies also need to have in-house capabilities that enable them to transform and leverage newly acquired knowledge, incorporating it into their operations to fully benefit from the pursuit of knowledge. Therefore, managers should not only monitor the external environments of their companies but also expand the internal mechanisms and routines of their companies, to put into practice the knowledge generated from the outside (Zahra and George, 2002). Third, since innovation and its outcomes are inherently uncertain, it is important for managers, especially those in a mature industry, to select collaborative partners based on the kind of knowledge and innovation their companies require.

4.7 Limitations

Our work is subject to some limitations, which could open up future lines of research.

First, the generalizability of this study is limited because the sample was taken only in the Italian context. Furthermore, this is an analysis by a single sector, the wine sector. The attributes of these companies may differ from the organizations of others operating in different industries and countries. Therefore, it would be interesting to address the mediating role of vertical and horizontal collaboration on the relationship between absorptive capacity and development of innovations, in other geographical contexts and taking into consideration companies belonging to other manufacturing sectors.

In addition, in the CFA, in this study, not all fit measures are reliable, this does not preclude this analysis from being reliable, as the literature predicts that for an acceptability of the model, not all fit measures may necessarily be reliable, however in the future the models could be refined to have slightly higher reliability.

4.8 References

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Appendix

	ACAP	COLL	PER_INN	SIZE
ACAP	0,845	0,322	0,225	0,098
COLL	0,322	0,703	0,558	0,274
INN	0,225	0,558	0,573	0,133
SIZE	0,098	0,274	0,133	1,000

Table 3. Correlations among latent variables and errors (Simple Model1)

	ACAP	COLL	PER_INN	SIZE
ACAP				
COLL	0,328			
INN	0,322	0,797		
SIZE	0,105	0,309	0,284	

Table 4. Heterotrait-Monotrait Ratio (HTMT) (Simple Model1)

	ACAP	COLL	SER_INN	SIZE	TECH_INN
ACAP	0,845	0,318	-0,032	0,099	0,277
COLL	0,318	0,703	0,350	0,273	0,514
SER_INN	-0,032	0,350	0,780	-0,112	0,288
SIZE	0,099	0,273	-0,112	1,000	0,200
TECH_INN	0,277	0,514	0,288	0,200	0,675

Table 7. Correlations among latent variables and errors (Simple Model2)

	ACAP	COLL	SER_INN	SIZE	TECH_INN
ACAP					
COLL	0,328				
SER_INN	0,120	0,598			
SIZE	0,105	0,309	0,192		
TECH_INN	0,427	0,839	0,763	0,313	

Table 8. Heterotrait-Monotrait Ratio (HTMT) (Simple Model2)

	ACAP	ORZ_COLL	SER_INN	SIZE	TECH_INN	VER_COLL
ACAP	0,846	0,269	-0,031	0,099	0,277	0,29
HORZ_COLL	0,269	0,782	0,286	0,259	0,416	0,541
SER_INN	-0,031	0,286	0,780	-0,111	0,286	0,337
SIZE	0,099	0,259	-0,110	1,000	0,200	0,217
TECH_INN	0,277	0,416	0,286	0,200	0,674	0,497
VER_COLL	0,293	0,541	0,337	0,217	0,497	0,829

Table 11. Correlations among latent variables and errors (Complex Model)

	ACAP	ORZ_COLL	SER_INN	SIZE	TECH_INN	VER_COLL
ACAP						
HORZ_COLL	0,286					
SER_INN	0,120	0,497				
SIZE	0,105	0,290	0,192			
TECH_INN	0,427	0,704	0,763	0,313		
VER_COLL	0,316	0,669	0,613	0,266	0,850	

Table12. Heterotrait-Monotrait Ratio (HTMT) (Complex Model)