Digitalization of the wine tourism experience: a literature review and practical applications

La digitalización de la experiencia enoturística: una revisión de la literatura y aplicaciones prácticas

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Abstract:
Technological evolution coupled with the use of ICT technologies and other digital communication resources, such as virtual reality, augmented reality and 4D technology, is transforming the tourism experience cycle. Wine tourism must adapt in order for a wine tourism experience to be unforgettable and, therefore, recommended, so it must be innovative and multisensory. A bibliometric analysis has been carried out based on the scientific literature related to the digitalization of the wine tourism experience and the use of digital communication resources. A total of 72 academic papers were examined, with the result that producers can increase the value of the hedonic experience by bringing the winery closer to the customer before, during and after the visit. A successful experience throughout the whole process leads to positive E-WOM (digital word of mouth) and to the creation of a loyal brand community.

Keywords:
Wine tourism and virtual reality; digitalization and ITCs; tourism experience cycle; wine marketing.

1. Introduction
In recent years, the use of the Internet and information and communication technologies (ICT) has led to the configuration of a new economy where globalisation has given way to digitalisation, which has transformed the way in which experiences are created and consumed. The tourism sector, due to its international nature, has witnessed the birth of new business models, markets and communication and sales techniques, (Buhalis, 1993, 1998; Buhalis, Jafari, and Werthner, 1997; Law, Buhalis, and Cobanoglu, 2014; Lewis and Bridger, 2001). This has totally changed the way in which the customer interacts with the destination (Mak, 2017).

Technologies offer the possibility for tourists to access information and establish a direct contact link with tourism service providers, in addition to generating richer, more participatory, and immersive experiences, resulting in increased user satisfaction. Wine tourism is defined as the visit to wineries, vineyards, festivals or fairs with the main motivation of tasting grapes and their products in the region where they are produced (Hall et al., 2000). Getz (2000) introduces the concept of niche markets, thus combining a form of consumer behaviour with a destination strategy, which is an opportunity for branding and marketing for wine companies.

The aim of the study is to inform the reader about the most important academic contributions made on the digitisation of the wine tourism experience, mentioning some relevant practical experiences that have been implemented by different wineries. For
this purpose, the general framework of wine tourism has been examined, analysing the literature on wine tourism and the use of ICT in wineries. In a second section, methodological questions have been addressed to analyse the impact of technologies on the tourist experience process. The results show how wineries have adapted to this phenomenon, becoming production sites and tourist attractions. Finally, the conclusions present a series of reflections on the digitalisation of wine tourism.

2. Methodology

Literature reviews are useful in many fields of research, most notably in the social sciences, as they serve to shed light on scientific intricacies (Mulrow, 1994). Documentary research can be organized by means of a literature review, but certain limitations to this methodology should be noted according to some experts such as Briner and Walshe (2014). Boote and Beile (2005) emphasise that the literature review can be considered as the first step in conducting meaningful research. The aim and scope of the review is based on the approaches suggested by Hart (1998) and Montella (2017). The first step of the review was to identify the purpose of the search. The main research question addressed is: what is the status of the art on the digitalization of the wine tourism experience? The second step was to identify keywords and sources. The search focused on the use of websites, social networks, virtual and augmented reality and the use of QR codes as relevant aspects in the digitalization experience of wine tourism visits. When identifying the keywords, synonyms were also taken into account and subsequently an analysis was carried out. Table 1 shows the combination of keywords chosen up to the year 2020.

<table>
<thead>
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The two most important databases, the Web of Science (WOS) and Scopus, were used to collect the full spectrum of possible relevant academic articles, supplemented by other academic sources focusing on the world of wine, such as the Journal of Wine Business Research, the Journal of Wine Research, the Journal of Wine Economics and Policy, AWBR and AAWE. The combination of multiple sources, as suggested by Tranfield et al. (2003), has broadened the number of sources examined.

A total of 72 academic papers were examined and 82% of the total were published from 2010 onwards. Table 2 shows the main results grouped by the different concepts encompassed by ICT. It should be noted that the selection was made in order to present papers that are specifically aimed at the wine tourism business. Another contribution of this literature review is the analysis of the impact of virtual and augmented reality and their combination on the consumer experience (Flavián et al., 2018), as well as the development of multisensory virtual experience models for wine tourism (Flavián et al., 2018).

Finally, the concept of smart tourism is identified in wine tourism management, which encompasses infrastructures that enable the management of tourism through digital communication resources, in a way that promotes smart opportunities and increases the efficiency of tourism businesses and the value that the customer gives to the experience (Gretzel, Zhong y Koo, 2016).

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Source: prepared by the authors. Them (Theme), Titl (Title), Ab (Abstract), Keyw (Keywords)
Table 2. Analysed studies classified by concepts

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<td>Cristofol, F.J. Zamarreño-Aramendia, G, de-San-Eugenio;I. (2020).</td>
<td>Effects of Social Media on Enotourism. Two Cases Study: Okanagan Valley (Canada) and Somontano (Spain). Sustainability, 12(17).</td>
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<td>Karimi, S.</td>
<td>A purchase decision-making process model of online consumers and its influential factor a cross sector analysis. In University of Manchester.</td>
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<td>Law, R., Buhalis, D., y Cobanoglu, C.</td>
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<td>Litvin, S. W., Goldsmith, R. E., y Pan, B.</td>
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3. Wine tourism and wine routes. A business opportunity

The development of new forms of tourism beyond the traditional holiday period has favoured the creation and dissemination of new tourism models based on natural environments and the enjoyment of local traditions (Cavicchi, 2013; Khartishvili, Muhar, Dax, Khelashvili, 2019; Privitera, 2010) the search for a new relationship with nature, of quality and safety of foodstuffs and in particular the need for “identity”, of characterizing places as bearers of values and traditions have led an increasing number of people to see rural areas as places of values, resources, culture and products to discover and enjoy. Agriculture has taken on a multifunctional role and link with tourism is required to protect and exploit its “historical” resources (heritage.

Wine tourism takes into account the interest of travellers in making trips and stays to get to know the landscapes where wine is produced, as well as to carry out activities that increase knowledge about this product, seeking progress in the wine-growing areas (Elias Pastor, 2006). It has therefore become one of the tourism products that has been able to adjust most quickly to the tourism panorama of the last few decades.

Wine tourism has developed all over the world. In Europe, in countries such as France, Italy, Spain, Portugal, Greece, Germany, Serbia, Romania or Georgia (Coros, Pop, y Popa, 2019; Dougherty, 2012; Festa, Shams, Metallo, y Cuomo, 2020; Khartishvili et al., 2019; Koch, Martin, Nash, 2013; López-Guzmán, Garcia y Rodríguez, 2013; Lourenço-Gomes, Pinto y Rebolo, 2015; Trišić, Štetić, Privitera y Nedelcu, 2020; Wolikow, 2014), and more intensively in the USA, Canada, South Africa, and New Zealand (Bruwer, 2003; Hall, Sharples, Cambourne, Macionis, Hall, et al., 2019; Hall, Sharples, Cambourne, Macionis y Telfer, 2019; Kirkman, Strydom, Van Zyl, 2013), as well as in emerging areas (Hojman y Hunter-Jones, 2012; Schlüter y Norrild, 2015).
Wine routes are defined as those circuits that delimit itineraries in a geographical area, with all the spaces that motivate tourists on their journey being duly marked. Getz y Brown (2006) established that the concept of wine tourism can be seen from three different approaches: as consumer behaviour, as a regional development strategy, and as an opportunity for wineries to market their products (Sigala, 2014).

The increase in the number of wine tourists is an opportunity for wineries to diversify their market. They must be able to offer a complete sensory experience (Santos, Ramos, Almeida and Santos-Pavón, 2019; Charters, and Pettigrew, 2005) in the three stages that comprise it: the pre-visit, the visit and the post-visit or nostalgia (Hall, Longo, Mitchell y Johnson, G. 1996).

Designing a wine tourism experience is not simple, it can be understood from four different perspectives (Getz and Brown, 2006b; Mănilă, 2012): gastronomic (Espejel, Fandos and Flavián, 2011; Millán Vázquez De La Torre, Morales Fernández, and Pérez Naranjo 2014), cultural (Getz et al., 2006; Williams and Kelly, 2001), natural heritage or terroir (Hall and Mitchell, 2002; Correia and Brito 2016) and educational (Buhalis y O’Connor, 2005).

The plurality of offers must always be designed around the main attraction, which is wine, assumed as a fashionable drink and linked to the consumption of a hedonistic experience (Bruwer, and Alant, 2009), which makes wine tourism a vital experience.

The search for pleasure as the main motivation when travelling makes wine tourists more demanding in terms of quality, personalisation and differentiation (Espejel et al., 2011). In addition, they are customers who value their time and seek personal growth through their visit (Buhalis and O’Connor, 2005), so it can be said that they also seek to satisfy epistemological needs (Charters, y Ali-Knight, 2002).

The high level of demand of wine tourists has become one of the biggest challenges for wineries, but it is also a great opportunity, since wine tourists that are satisfied with the experience recommend it to a greater extent than ordinary tourists (Ruiz-Romero de la Cruz, Zamarreño-Aramendia and Cruz-Ruiz, 2020). Due to its sociable nature (Laverie, Humphrey, Velikova, Dodd, and Wilcox, 2011), about 95% of visitors to wineries or vineyards are accompanied (Bruwer, and Reilly, 2006). According to data collected by ACEVIN (2019), the level of satisfaction of wine tourists is 8.56 points out of 10, and 99.4% of visitors would recommend the visit.

### 4. The stages of the visit and the literature review

Communication plays a key role in shaping the wine tourism experience, as wine is a holistic product (Cristofol, Zamarreño-Aramendia, De-San-Eugenio, 2020). The different digital channels complement each other to ensure and reinforce the visitor’s experience on-site. The stages of the visit have been defined by various authors including Hall and Macionis (1998), Hall et al (2006), Fuentes, Moreno-Gil, González and Ritche (2015), Rodríguez Zulaica (2016); or Fernández-Cavia, Vinyals-Mirabent, Fernández-Planells, Weber, and Pedraza-Jiménez (2020), among others.

#### 4.1. Pre-visit stage

Initially, the pre-visit stage is initiated by a desire rather than a need, as the wine tourist is guided by hedonistic impulses (Holbrook, and Hirschman, 1982). Here the imagination is in charge of generating the expectations about the visit, together with the study of previous experiences of other consumers (Carù, and Cova, 2003). Companies must focus on exceeding these
expectations at the on-site experience stage, in order to impose themselves as the preferred option over their competitors. To do so, they must take into account that the customer must feel involved in the experience, surprised by the novelty, and must be provided with knowledge about the wine culture and its environment. The combination of all these particularities will generate the feeling of nostalgia in the post-purchase stage (Crespi-Vallbona, y Mascarilla-Miró, 2020).

For the search for information, wine tourists prefer to turn to informal channels external to the winery itself, where the content is generated by previous visitors (Wu, 2013). The importance of eWOM (digital word of mouth) gaining ground over WOM (word of mouth) lies in the public and open nature of eWOM, which allows the winery to control what others say about its brand and its experience, in order to offer a consumer-centric orientation (Dellarocas, 2003; Jalilvand, Esfahani, and Samiei, 2011). This search for information must be supported in the digital world through the use of websites, which in most cases represent the first contact of the customer with the winery and its wines (Cho, y Sung, 2012).

Any tourist destination should have a website (Jeong, Holland, Jun, and Gibson, 2012), as the correct use of this communication channel generates a positive image and increases the intention to visit (Llodrà-Riera et al., 2015). There should be links to the winery’s social networks, which encourage customer participation in these platforms (Davidson y Keup, 2014).

Social networks are essential for sharing audiovisual content from the winery and interacting in a more direct way with the customer. In this way, there is an increase in online conversation (Molinillo, Liébana-Cabanillas, Anaya-Sánchez, and Buhalis, 2018) and the creation of a brand community is easier (Zeng, and Gerritsen, 2014). In line with this marketing strategy, nowadays the use of “influencer marketing” is also essential, as it has a great impact on the purchase decision (Yang, Huang, and Yang, 2011). It is a much more informal and direct promotion from the ‘voice’ of experience, which conveys greater trust than traditional means of promotion.

Consumers will be more intensely involved the higher the level of participation in the creation of content and, therefore, the degree of trust by the potential customer in the information offered will increase, since, as Wu (2013) points out, the potential customer takes into account the opinions of friends or references in the world of wine more than the information offered by the winery itself. As Molinillo et al. (2018) indicate, wineries must necessarily be present on the most popular social networks, Instagram, YouTube and Facebook, whose characteristics for the creation of advantages are shown in Table 3.
Since the wine tourism experience is so influenced by the senses (Getz, 2000), each tourist experiences it in a totally different way (Cho et al., 2017), which increases the risk of mismatches between the expectations generated by the consumer in this preliminary stage of choice and what is actually experienced during the visit (Carlsen, and Boksberger, 2015). To overcome this issue, the greater the similarity between the information received in this stage and reality, the greater the satisfaction of the wine tourist (Ku, and Chen, 2015). To achieve this approach to reality and to have more detailed information about the on-site experience, this model proposes the use of augmented reality and virtual reality (Marasco, Buonincontri, Van Niekerk, Orlowski, and Okumus, 2018). The combination of all these digital resources allows the tourist to generate a strong emotional bond with the destination (Huang, Backman, Backman, & Moore, 2013). And being a ‘try before you buy’ experience (Tussyadiah, Wang, Jung, & Dieck, 2018) greatly increases the intention to visit (Marasco et al., 2018).

### Table 3. Social networks and their characteristics in relation to wine tourism

<table>
<thead>
<tr>
<th>Social network</th>
<th>Characteristics in relation to wine tourism</th>
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</thead>
</table>
| Instagram      | • Instagram was designed for sharing photos and short videos and it allows interaction with other users, publicly through comments and likes and privately through private messages (Geurin-Eagleman y Burch, 2016).  
• New formats for sharing content: stories with 15-second videos or photos that disappear after 24 hours; IGTV, a strong competitor to YouTube; and finally live videos. The stories tool is expected to generate 7.5 billion dollars by 2021 (Fondevilla-Gascón et al., 2020).  
• This social network is the one with the biggest differences in the process of creating a destination image compared to websites. It does not require a high level of involvement on the part of the consumer, as browsing and interacting on it is simple. It has the highest values for post-consultation visit intention and for increasing the overall destination image, accounting for 50% of the deviation in visit intention in the study. It is the best platform for both building destination image and attracting tourists (Fantani y Suyadnya, 2015). |
| Facebook       | • Facebook allows the creation of public profiles, both personal and business, where personal information, contact information, etc. can be uploaded. It connects users, organisations and brands, being able to share all kinds of audiovisual content and interact with them both publicly and privately (Davies, Musango y Brent, 2016).  
• It requires a high level of involvement on the part of the tourist, i.e., it presents a higher motivation in relation to the company, which positively influences the destination image. The positive influence on visit intention is lower than that presented by Instagram or the website itself. Even YouTube explains more of the deviation in visit intention than this platform. |
| YouTube        | • YouTube is the world’s most widely used platform for sharing videos, in addition to allowing interaction through comments and likes (Smith, Fischer y Chen, 2012).  
• YouTube has introduced the novelty of live chats in which creators interact at the moment the video is released, in search of a more direct interaction due to the loss of market share to other platforms, such as Instagram Videos (IGTV).  
• It is the platform with the lowest level of user involvement of the three analysed, which means that its influence on the creation of the destination image is practically non-existent and the lowest in comparison with the other platforms, where the website is included. This pattern is repeated with respect to the influence on the intention to visit, which shows that it is the least attractive platform when it comes to attracting customers. |
4.2. On-site experience

It is at this stage that feelings of satisfaction or dissatisfaction arise in relation to the wine tourism visit and, therefore, in relation to the brand (Howell, and Guevarra, 2013). However, there are few studies that have measured the impact of the on-site experience on consumer behaviour. Despite this, the academic literature agrees that the success of creating memorable experiences depends on the winery’s ability to generate a unique impact that exceeds the expectations of wine tourists. Experiences that are capable of generating a positive eWOM and the possible repetition of the customer (Hosany y Witham, 2010; Fernandes et al., 2016)

In order to satisfy the customer needs during their visit, it is necessary to identify the wine tourist through market segmentation (Alebaki, and Iakovidou, O. 2011; Cho, Bonn, Brymer, 2017; Bruwer et al., 2009). The study by Cho et al. (2017) distinguishes wine tourists into five segments according to the limitations that potential tourists encounter when making the decision to visit. Of these five segments, two stand out as the most interesting when it comes to directing the creation of the experience. On the one hand, the segment of those who encounter minimal limitations and are therefore very attracted to the idea of making the visit. The only limitation reported by this group is the lack of time and money, although to a much lesser extent than the average of the other groups. The other interesting segment is that of families, which have even fewer restrictions with respect to time and money, indicating that their economic capacity is higher than average. The main limiting factor reported by this group is the lack of plans or activities for families during the visits.

Another peculiarity of both segments is that they tend to be customers who have already made similar visits and who have higher than average intentions, both in terms of their willingness to take part in wine tourism activities, to pay extra for them and to recommend them after a positive experience. These characteristics are key in differentiating the wine tourist from the traditional “sun and beach” tourist; wine tourists are experienced tourists with knowledge about wine and are therefore much more demanding in terms of the services they wish to receive (Brown, y Getz, 2005)

When visiting a winery, wine tourists seek to learn about the relationship between the vineyard, the wine and the surrounding rural environment. They want to learn more about the product, and they are also curious about the region and its people (Hall and Mitchel, 2007). Thus, we can speak of educational tourism motivated by situations where the experience is spontaneous, authentic and innovative compared to the way other wineries present their experiences (Jung, y Cho, 2015). Making use of QR codes to expand the information of the traditional tour or creating new experiences through the use of CAVE technology, which consists of a room where the virtual environment is projected onto the walls, ceiling or floor as programmed (Martins et al., 2017). These technologies are inexpensive and can even save staff costs. In addition, families travelling with children are entertained by digital media, generating greater satisfaction in the visit.

At this stage, the content of the experience is very similar to what was already on offer, but the method by which the consumer is approached is what brings the great novelty that the customer is looking for to build a positive and memorable experience (Flavián et al., 2018; Tussyadiah et al., 2018).
4.3 Post-purchase or nostalgia stage

Memory plays a fundamental role once the trip is over, as it is the main element in the reconstruction of the sensations experienced in situ. Memories tend to generate uncertain sensations, thus magnifying positive experiences and detracting from negative ones (Mitchell, Thompson, Peterson y Cronk, 1997).

Nowadays, anyone can become a photographer with their smartphone, which facilitates the process of remembrance. Until recently, this process was only possible through the imagination, acting as a reminder of the lived experience (Swanson, 2004). The fact of introducing images that must be taken at different points favours the artistic and personal development of the customer and, at the same time, benefits the winery, as on many occasions the images taken by the customers communicate a message that the winery has not been able to reflect or that, when not being seen through the eyes of a tourist, has not been considered interesting (Stepchenkova y Zhan, 2013).

At this stage, customers must stop being mere spectators and become fans, who are loyal customers with a greater tendency to repeat visits and to recommend it to friends and family (Dodd, 1999). It is very important that the social networks become a community that provides value and are not only based on promotional content, as it should encourage the customers to give their opinion about the brand freely and help them to connect with other followers, as well as with the winery itself (Dolan et al., 2017).

4.4. New technologies and wine experience tourism. Some examples

Wine tourism has not remained oblivious to the changes and possibilities offered by technology in order to offer a differentiating and enriching experience for wine tourists in the pre-visit and during the visit, so as to provide an incentive for traditional wine tastings in the winery facilities, thus exploring new needs of wine tourists (Getz, 2000; Pasternak, 2004; Garibaldi and Pozzi, 2018).

The most widely used technology is the one that takes advantage of the potential offered by virtual reality (Garibaldi and Sfodera, 2020), providing enormous possibilities, both in the field of education and learning and in the field of recreational applications, being especially useful in environments that are difficult to access (Guttentag, 2010).

In the Spanish case, two wineries that have opted for this type of technology have been analysed: Bodegas Ramón Bilbao and Bodegas Gandía. The former, located in Haro (La Rioja), has made an effort to develop innovative products and services that attract wine tourists. In this way, visitors can make use of the “Oculus Rift” technology, based on virtual reality, which allows wine tourists to learn about the entire winemaking process. This technology is used to present the products that can later be tasted, offering an audiovisual experience that transcends physical barriers, where the wine and its landscape are the main subject. To this experience is added the educational value, as it allows the visitor to learn about the history and values of the winery and the surrounding environment (bodegasramonbilbao.es, 2018).

The Valencian winery Bodegas Gandía, together with its distributor in the Netherlands, opted in 2017 to offer a virtual reality experience at the Samsung Galaxy Studio in Amsterdam, through the Samsung Gear VR device. The aim was to bring the wineries closer to future customers by awakening their interest in the pre-visit stage, offering a tasting at their estate in Hoya de las Cadenas, where their wine tourism centre is located. Technology makes it possible to eliminate the barriers imposed by distance and enjoy six selected wines, as well as their history and peculiarities. The winery itself defines the experience as a way of bringing oenology closer to the end consumer in an innovative way, breaking with the traditional codes that prevail in the world of wine.
In the antipodes, two cases deserve to be mentioned. Firstly, the Australian winery Seppeltsfield, which has a 165-year history. In this case, users use their own mobile phones accompanied by virtual reality goggles to take a tour of the Barossa Valley estate, so that wine tourists have the opportunity to enjoy panoramic views that show them the art, food and wine immersed in the winery’s grounds. In addition, visitors to the website can enjoy 360º tours of the winery’s facilities. Furthermore, the tour can also be accessed via a link to the website or by scanning a Quick Response (QR) code, which Seppeltsfield has begun to include on the labels of its wines (seppeltsfield.com.au, 2020).

In New Zealand we find Brancott Estate, a winery with more than 40 years producing wines, which stands out for its commitment to innovation and sustainability in winemaking. In 2016 it launched the “Red Shed Experience”, using virtual reality to make itself known at its corporate events. Through the use of a virtual reality device, users can visit the vineyards and winery, discovering the maturation and winemaking process. In this case, specific devices are used that release aromas of grapes and fruits, which help wine tourists to have a complete immersive experience (brancottestate.com 2018).

5. Conclusions

The literature review reflects the speed of change affecting digital communication and, more specifically, wine tourism. If wineries want to adapt to the new market reality, they must modify their business model by digitalizing all stages of the visit process. Figure 1 summarises each of the aforementioned stages, showing their capacity to reach new segments, consolidating previous ones and offering novelty and satisfaction, which results in an increase in the loyalty of visitors and potential consumers.

Figure 1: Digitalisation and stages of the wine tourism visit

Source: prepared by the authors based on the literature review
Today we must speak of smart tourism as the future of the market (Shen, S., Sotiriadisforajidos, and Zhang, 2020) and, therefore, wineries must not be left out of the wave of renewal and adaptation, or they will run the risk that their claim as a tourist destination will never reach the level of other competitors. The use of digital resources to educate wine tourists provides the novelty, authenticity, and spontaneity they need to generate and reinforce their positive feelings towards the winery.

Throughout the literature review, it has been shown that technologies have evolved in such a way that they can offer solutions that allow users to virtually participate in increasingly realistic immersive experiences. Baus and Bouchard (2016) and Delplanque et al. (2008) point out the great possibilities of developing multisensory experiences thanks to technology. The interaction of users of websites related to the world of wine must become as immersive an experience as possible. A large number of wineries have adopted and implemented websites that combine different social networking tools, covering the decision-making process from the initial information search to the pre- and post-communication with potential consumers and wine tourists (Canovi y Pucciarelli, 2019).

In many ways, the eWOM demonstrates many characteristics of the modern tourism consumer. The ability to obtain information and opinion in real time and convert it into usable data in the more or less immediate future highlights the growing importance of the use of ICT to recognise and enhance the tourism experience by eliminating geographical and social barriers. In this way, the use of different digital resources is an advantage that can add to the knowledge of the wineries and the wines marketed. At present, wineries benefit only to a very limited extent from the full range of possibilities.

In the digital world of wineries, the lack of development of marketing campaigns implies the loss of opportunities to consolidate current customers and reach a new potential demand, which would result in a more sustainable tourism. On the other hand, the advantages associated with the public nature of eWOM, in contrast to the privacy of WOM, are being wasted, which allows a much more customer-oriented product to be offered, solving and responding to the mismatches encountered by the customer between expectation and reality.

Several gaps have been detected that should be taken into account as new ways of research in the development of wine tourism, both from a theoretical and practical point of view. The profile of wine tourists is known, how they relate to the environment, how they interact, how they seek to live a differentiating experience and how they express their degree of satisfaction. Although all this information is of great value for the digitalization process, there is a lack of research on the digital experience linked to wine tourism or its adaptation to the concept of smart tourism.

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7. Bibliographical references


Digitalization of the wine tourism experience: a literature review and practical applications


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