

# 13 From Wine to Screen: Impacts of Technology on Wine Tourists

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## The main aims of this chapter are to:

- Examine how new technologies affect wine tourist's satisfaction and intentions to revisit the Douro Wine Region in Portugal
- Explore how wine tourists use new technologies in their wine tourism experiences, and their effect on tourist satisfaction, recommendation, and revisit intentions

## Introduction

Wine tourism has become an increasingly important and recognised area within the tourism sector, showing steady growth worldwide (Santos et al., 2022). Traditionally, wine tourism was necessarily done with a physical presence and visitors travelled to wine-producing regions primarily to enjoy tastings at wineries, engage with winemakers, and enjoy scenic vineyards (Charters & Knight, 2002). However, in recent years, new technologies have had a profound impact on wine tourism (Prodan et al., 2024) and people can have an immersive wine experience, such as a traditional grape-treading activity, without physically being there, with the use of virtual reality (Sousa et al., 2024).

Sigala (2023) stresses that in response to growing global competition and accelerated by the COVID-19 crisis, digital transformation is essential for making the wine tourism industry more competitive. Recent developments in technology that are helping to modernise the wine industry include blockchains, mobile apps, social media, and crowdfunding, as well as virtual and augmented reality (Sigala, 2023).

There is much research addressing technology use in tourism, and it has grown rapidly in the late 2000s, after the widespread adoption of touchscreen mobile

phones (Yuan et al., 2019, Zhong et al., 2021). However, and despite its many potential applications and advantages, technology's use in wine tourism has received little attention (Garibaldi & Sfodera, 2020). Recognizing this, several researchers have called for more research on this topic (e.g., Garibaldi & Sfodera, 2020; Sigala, 2023; Zamarreño et al., 2021). Therefore, this study aims to explore how wine tourists use new technologies, such as Google Maps, VR/AR applications, and other mobile apps, and their effect of wine tourists' satisfaction and behavioural intentions, particularly their willingness to recommend and intentions to return. The findings provide valuable insights that can help to better understand the impact of these technologies on wine tourists' experience.

The region chosen for this study was the Douro Wine Region, in Portugal. This is one of the oldest demarcated wine regions in the world (Pereira, 2021) and has been considered one of Portugal's most important wine-producing regions for centuries (Correia et al., 2019). In 2024, Portugal achieved a record number of 11 wineries in the World's Best Vineyards Top 100, with six of these located in this region (Pereira, 2024).

## New technologies and wine tourism

It is well known that new technologies have transformed the tourism industry, as pointed out by several researchers (e.g., Buhalis, 2020, Chon & Hao, 2025, Pencarelli, 2019). Numerous technological innovations are reshaping the tourism landscape, such as machine learning, artificial intelligence, the industrial web, big data, the Internet of Things (IoT), smart devices, robotics, drones, sensors, beacons, virtual and augmented reality and near-field communication (Sigala, 2018).

Research has also evidenced that new technologies have many positive impacts on tourists, such as enhancing visitor experience (Samala et al., 2020, Stankov & Gretzel, 2020), satisfaction (Azis et al., 2021, Ku & Chen, 2024, Zhang et al., 2022) and loyalty (Azis et al., 2021, Zhang et al., 2022).

In the particular case of wine tourism, the use of new digital technologies can help wine regions and service providers to improve the visitor experience (Prodan, 2024). Wine tourism is increasingly adopting technological innovations, particularly in digital marketing and immersive technologies, to promote and enhance tourist experiences (Piras, 2024). New technologies have a positive impact on wine tourists' satisfaction by providing richer and more immersive experiences (Garibaldi & Sfodera, 2020).

Wine tourism visits, like tourism in general, have been divided into three stages: before the visit, during the experience (Bruwer & Alant, 2009, Mitchell et al., 2000, Thanh & Kirova, 2018, with technology playing an important role in all of these stages (Buhalis, 2020). Figure 13.1 shows the technological touchpoints at each phase in the wine tourism experience.



**Figure 13.1:** Phases of the technological experience

Technology-enabled tourism experiences increasingly support travellers in the co-creation of value at all stages of the journey (Buhalis, 2020). The wine tourism experience usually begins with planning and looking for information online, using websites, social media, and online booking platforms (Liberato et al., 2020). Recent studies show that wineries are increasingly turning to digital tools and social media to strengthen their marketing, enhance consumer engagement, and attract more wine tourists (Alebaki et al., 2022, Cerquetti & Romagnoli, 2023, Prodan et al., 2024, Vilcea et al., 2024). In this stage, tourists create expectations, often by reading about other people's experiences (Zamarreño et al., 2021). These digital tools are important for the wine industry, but especially for small wineries, because they allow them to communicate what makes their wines and regions unique in a cheaper way than traditional marketing methods (Finotto & Mauracher, 2020).

Wine tourists can use digital maps and GPS-enabled itineraries to plan their trips, by creating personalized wine routes before travelling to make the most of their journey (Hall, 2025).

At the destination, the visitor's experience at wineries can be with interactive technology. Touchscreens, digital signage, and tools like virtual and augmented reality (VR/AR) can make the visit more immersive and educational (Huang et al., 2017). Many studies highlight the growing use of AR and VR to enhance wine tourism through immersive tools such as virtual winery tours, interactive cultural experiences, and simulated tastings (Piras, 2024). Wineries are using AR, with

interactive wine labels that, when seen on a smartphone, come to life and offer details about the wine, where it was made and suggests food pairings (Hall, 2025). Visitors of the Banfi estate vineyard can use AR to enhance their experience scanning QR codes to access information through an app (Velasco et al., 2024).

In a recent study conducted by Sousa et al. (2024) regarding an experimental VR experience with digital content about a wine tourism activity, the results revealed that satisfaction from the experience lead to a significant effect on the intention to visit and to recommend the destination and the VR activity itself. Virtual and augmented reality technologies allow remote vineyard explorations, promoting the intention to visit the wine destination (Martins et al., 2017, Sousa et al., 2024). Bodegas Ramón Bilbao in Spain offers a virtual reality experience that replicates the journey of the wine, allowing people to explore the vineyard environment throughout the year in a creative way (Garibaldi & Sfodera, 2020). The wine museum “La Cité du Vin” in Bordeaux, also integrates a high level of technology to visitors, with 100 video players and servers, 50 video projectors and more than 200 connected screens and personalized smartphones (Kirova, 2020). It should be noted, however, that if the technology is not used in the right way, it can make the experience worse, with visitors feeling confused and disconnected because of how the digital tools were set up (Kirova, 2020).

In the post-purchase stage, Velasco et al. (2024) suggest using IoT technologies such as personalised recommendations (for music and wine), to help extend the wine experience beyond the visit by linking past preferences to future consumption, enhancing the sensory atmosphere and deepening consumer engagement.

## Emerging trends and challenges

Offering touchless wine experiences and/or wine events is no longer a luxury but a standard expectation of contemporary wine tourists who desire to remain connected, share and co-create other wine tourism experiences with others remotely, as well as utilise technologies to enrich what they see, feel, learn, and understand in wine tourism contexts (Sigala, 2023). Innovation in wine tourism will involve investing in process and product innovations that examine how wine tourism experiences are designed, promoted, communicated, and delivered (Sigala & Robinson, 2019).

While technological advancements offer immense benefits, challenges persist. Many wineries lag adopting digital tools (Finotto & Mauracher, 2020; Wadewitz, 2023) and underutilise available tools, such as interactive websites, blockchain, and advanced VR/AR applications (Martens, 2024). Smaller wineries often face resource constraints, limiting their ability to effectively adopt innovative solutions (Sears & Weatherbee, 2023). Collaboration between wineries, tourism boards, and tech providers is vital for overcoming these barriers. For example, virtual crowdfunding platforms could help smaller wineries integrate new technologies while

engaging their audience (Sigala, 2023). Strategic planning and innovation ensure technological advancements align with consumer expectations and sustainable practices.

## Methodology

A questionnaire was developed for this study, comprising items designed to measure wine tourists' use of technology, their satisfaction with this use, and their behavioural intentions. Initially, participants were requested to provide their perspectives on utilising technologies in the Douro region, employing items derived from the study by Leal et al. (2018). These items were categorised into positive aspects (essential for the trip, enhancing the tourist experience, enabling the capture and storage of experiences) and negative (difficult to use, distracting, slow, and unnecessary). Participants responded on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

Additionally, participants provided ratings of their technology usage while visiting the Douro Region, as presented in Table 13.1, on a 5-point Likert scale, with 1 = Never and 5 = Very Frequently. The items were based on Jeong and Shin (2020). The items regarding the apps were new. Four items adapted from Um and Chung (2021) and Jeong and Shin (2020) were used to measure satisfaction, with responses recorded on a five-point Likert scale.

**Table 13.1:** Technologies used while visiting the Douro Region

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|  |
|--|
| Google maps  |
| Official destination website   |
| Social media with reviews and ratings of tourist attractions (Tripadvisor, Yelp, etc.) |
| Free WiFi  |
| Contactless or online payments via mobile  |
| Official social media of the destination   |
| Official destination apps (e.g. museums, restaurants, traffic, etc.)                   |
| Official destination booking platforms   |
| Apps related to wine and wine tourism (e.g., Vivino, Wine Spots)                       |
| Cycling. Walking and running trail apps (e.g. Alltrails, ViewRanger)                   |
| Online translators (e.g. Google translator)  |
| Video site guides  |
| QR Codes   |
| Automatic battery charging stations (e.g., electric cars, cell phones, etc.)           |
| Touchscreens   |
| Augmented reality  |
| IoT (Internet of Things)   |
| Virtual Reality  |
| Smartwatch   |
| Chatbots   |
| Beacons  |

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Researchers have only recently started to explore how new technologies might influence tourists' loyalty to a destination, and there are few studies (e.g., Almeida-Santana & Moreno-Gil, 2017; Mirzaalian & Halpenny, 2021; Zollo et al., 2022). Zollo et al. (2022) found that digital experiences in a museum increased loyalty. To further examine if the use of new technologies could impact destination loyalty, the questionnaire included two questions asking the respondents about the likelihood of recommending the destination and the likelihood of returning. These questions were adapted from the studies of Azis et al. (2020) and Jeong and Shin (2020) and were measured on a 5-point Likert scale.

A pre-test of the questionnaire, originally developed in Portuguese, was conducted with five people who had already visited the Douro Region. Based on their feedback, some adjustments were made before translating it to English and French.

### Data collection

The questionnaire was made available online using Google Forms. Since the target audience were people who had visited the Douro Region, posters containing a QR code linked to the questionnaire were displayed in key locations across the Douro region, including train stations, hotels, tourist offices, and wineries. Furthermore, the questionnaire link was also shared in relevant wine and wine tourism groups on social media platforms such as Facebook and LinkedIn. Data collection occurred in 2022, during the region's peak tourist season, from July to October, resulting in 207 responses.

### Data analysis

A factor analysis was performed on all items, revealing two distinct factors: the use of utilitarian technologies and the use of advanced technologies. Partial Least Squares Structural Equation Modelling (PLS-SEM) was employed to examine the influence of these factors on satisfaction and behavioural intentions.

## Results

Table 13.2 provides a statistical overview of the wine tourists' socioeconomic characteristics. The total sample consisted of 207 respondents, comprising 53.1% females ( $n = 110$ ) and 45.9% males ( $n = 95$ ). Regarding the age distribution, Generation Y constituted the largest group, representing 40.6% ( $n = 84$ ) of the sample. In terms of respondents' nationality, 68.6% ( $n = 142$ ) were Portuguese, while 10.6% ( $n = 22$ ) were American, 4.3% ( $n = 9$ ) English, 2.9% ( $n = 6$ ) Canadian, and 1.9% ( $n = 4$ ) Spanish. Additionally, 11.7% ( $n = 24$ ) of the respondents were identified as belonging to other nationalities. The educational background of the sample indicated a highly educated group, with 83.1% ( $n = 172$ ) holding a university-level degree.

**Table 13.2:** Demographic profile of respondents

| <b>Respondents' profile</b> | <b>N=207</b> | <b>%</b> |
|-----------------------------|--------------|----------|
| <b><i>Gender</i></b>        |              |          |
| Male                        | 95           | 45.9     |
| Female                      | 110          | 53.1     |
| No reply                    | 2            | 1.0      |
| <b><i>Age</i></b>           |              |          |
| Generation Z (18-28 years)  | 35           | 16.9     |
| Generation Y (29-45 years)  | 84           | 40.6     |
| Generation X (46-58 years)  | 62           | 30.0     |
| Baby Boomers (59-77 years)  | 26           | 12.6     |
| <b><i>Nationality</i></b>   |              |          |
| Portuguese                  | 142          | 68.6     |
| American                    | 22           | 10.6     |
| English                     | 9            | 4.3      |
| Canadian                    | 6            | 2.9      |
| Spanish                     | 4            | 1.9      |
| Other                       | 24           | 11.7     |
| <b><i>Education</i></b>     |              |          |
| Primary school              | 5            | 2.4      |
| High school                 | 30           | 14.5     |
| University                  | 172          | 83.1     |

### **Descriptive statistics**

Regarding respondent's perceptions of the use of technologies, while visiting the Douro, the findings indicate that respondents generally perceive technology as having a positive influence on wine tourism experiences in the Douro region (Table 13.3). This indicates that technology plays an important role in enhancing the quality of wine tourism, particularly by facilitating planning and organisation. Conversely, the mean values for negative aspects are notably lower, indicating that respondents generally do not perceive technology as a significant obstacle and that most view it as a valuable tool for tourism activities.

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**Table 13.3:** Perceptions of technology used in Douro wine tourism

| <b>Positive Aspects</b>                       | <b>Mean</b> |
|---|-------------|
| Essential for the trip                        | 3.72        |
| Enhance the tourist experience                | 3.55        |
| Enable the capture and storage of experiences | 3.49        |
| <b>Negative Aspects</b>                       | <b>Mean</b> |
| Difficult to use                              | 2.31        |
| Distracting                                   | 2.18        |
| Slow  | 2.45        |
| Unnecessary                                   | 2.14        |

Table 13.4 provides various technologies in wine tourism in the Douro region (utilitarian and advanced technologies), satisfaction, and behavioural intentions.

**Table 13.4:** Descriptive statistics for construct items

| <b>Construct/Indicators</b>   | <b>Mean</b> |
|---|-------------|
| <b><i>Utilitarian Technologies</i></b>  | <b>3.20</b> |
| UT1 - Google maps   | 4.38        |
| UT2 - Official destination website  | 3.61        |
| UT3 - Social media with reviews and ratings of tourist attractions (Tripadvisor, Yelp, etc)                           | 3.57        |
| UT4 - Free WiFi   | 3.34        |
| UT5 - Contactless or online payments via mobile   | 3.33        |
| UT6 - Official social media of the destination  | 3.31        |
| UT7 - Official destination apps (e.g. museums, car parks, restaurants, traffic, etc.)                                 | 3.07        |
| UT8 - Official destination booking platforms  | 3.01        |
| UT9 - Apps related to wine and wine tourism (eg Vivino, Wine Spots, Hello Vino, Tipple, Alle Wine, etc.)              | 2.84        |
| UT10 - Cycling, walking and running trail apps (e.g. Alltrails, ViewRanger Maps, Trails, Walk with Map My Walk, etc.) | 2.74        |
| UT11 - Online translators (eg Google Translator, Skype Translator, iTranslate Voice, etc.)                            | 2.68        |
| UT12 - QR Codes   | 2.51        |
| <b><i>Advanced Technologies</i></b>   | <b>2.04</b> |
| AT1- Video site guides  | 2.64        |
| AT2- Automatic battery charging stations (e.g. electric cars and cell phones)   | 2.16        |
| AT3- Touchscreens   | 2.11        |
| AT4- Augmented reality  | 2.06        |
| AT5- IoT (Internet of Things)   | 2.06        |
| AT6- Virtual Reality  | 2.00        |
| AT7- Smartwatch   | 1.96        |

|  |             |
|--|-------------|
| AT8- Chatbots  | 1.74        |
| AT9- Beacons   | 1.67        |
| <b>Satisfaction</b>  | <b>3.58</b> |
| SAT1 - Technologies can increase my satisfaction in the Douro destination                    | 3.74        |
| SAT2- Douro as a smart destination, makes my trip more pleasant                              | 3.52        |
| SAT3 - Technologies in the Douro allow me to have unique experiences and that makes me happy | 3.49        |
| <b>Behavioural Intentions</b>  | <b>4.67</b> |
| BI1 - Intentions of revisiting   | 4.58        |
| BI2-Probability of Recommending  | 4.75        |

Utilitarian technologies received higher mean scores ( $M = 3.20$ ) than advanced technologies ( $M = 2.04$ ), indicating that respondents prioritised practical, widely used tools such as Google Maps, official destination websites, and social media platforms with reviews and ratings. Conversely, advanced technologies such as augmented reality, virtual reality and chatbots were rated lower, suggesting either limited adoption or inexistence in the wineries visited.

Satisfaction levels were relatively high ( $M = 3.58$ ), with respondents agreeing that technologies enhance their satisfaction with the Douro destination and contribute to unique, enjoyable experiences. Behavioural intentions showed even stronger positive responses, with high mean scores for both the likelihood of revisiting ( $M = 4.58$ ) and recommending the destination to others ( $M = 4.75$ ).

### Model assessment

PLS-SEM was performed to examine the influence of technology use on satisfaction and loyalty. The PLS-SEM model was assessed by examining the measurement model, also referred to as the outer model in PLS-SEM. This assessment focuses on determining the reliability and validity of the construct measures. The results of applying the PLS algorithm to SmartPLS are presented in Table 13.5.

To evaluate indicator reliability, the indicator's outer loading should be above 0.70 (Hair et al., 2022). However, consistent with Hair et al. (2022), an evaluation of how item removal would affect composite reliability, and the content validity of the construct was conducted to guide the decision on which items to discard. Indicators with outer loadings lower than 0.675 were excluded. Therefore, the technologies UT1 Google Maps, UT4 Free Wifi, UT5 Contactless online Payments, UT11 Online Translators were deleted (and are not presented in Table 13.5).

The composite reliability values for all constructs ranged between 0.87 and 0.95, meeting the acceptable threshold of 0.7 (Hair et al., 2022). Regarding convergent validity, the average variance extracted (AVE) values were above 0.5, confirming that the constructs explained more than 50% of the variance in their indicators (Fornell & Larcker, 1981).

**Table 13.5:** Measurement statistics of construct scales

| Construct/Indicators            | Indicator Loadings | t-value (a) | Composite reliability | Cronbach's alpha | Average Variance Extracted |
|---------------------------------|--------------------|-------------|-----------------------|------------------|----------------------------|
| <b>Utilitarian Technologies</b> |                    |             | <b>0.89</b>           | <b>0.86</b>      | <b>0.51</b>                |
| UT2                             | 0.73               | 20.077      |                       |                  |                            |
| UT3                             | 0.70               | 18.827      |                       |                  |                            |
| UT6                             | 0.81               | 31.587      |                       |                  |                            |
| UT7                             | 0.72               | 19.785      |                       |                  |                            |
| UT8                             | 0.68               | 15.153      |                       |                  |                            |
| UT9                             | 0.71               | 17.461      |                       |                  |                            |
| UT10                            | 0.68               | 14.801      |                       |                  |                            |
| UT12                            | 0.69               | 17.371      |                       |                  |                            |
| <b>Advanced Technologies</b>    |                    |             | <b>0.95</b>           | <b>0.94</b>      | <b>0.68</b>                |
| AT1                             | 0.79               | 26.238      |                       |                  |                            |
| AT2                             | 0.72               | 18.469      |                       |                  |                            |
| AT3                             | 0.81               | 22.069      |                       |                  |                            |
| AT4                             | 0.91               | 68.715      |                       |                  |                            |
| AT5                             | 0.86               | 26.269      |                       |                  |                            |
| AT6                             | 0.91               | 64.047      |                       |                  |                            |
| AT7                             | 0.71               | 13.627      |                       |                  |                            |
| AT8                             | 0.86               | 31.556      |                       |                  |                            |
| AT9                             | 0.85               | 31.448      |                       |                  |                            |
| <b>Satisfaction</b>             |                    |             | <b>0.94</b>           | <b>0.91</b>      | <b>0.85</b>                |
| SAT1                            | 0.92               | 51.602      |                       |                  |                            |
| SAT2                            | 0.94               | 89.639      |                       |                  |                            |
| SAT3                            | 0.91               | 41.285      |                       |                  |                            |
| <b>Behavioural Intentions</b>   |                    |             | <b>0.87</b>           | <b>0.71</b>      | <b>0.78</b>                |
| BI1                             | 0.89               | 11.006      |                       |                  |                            |
| BI2                             | 0.87               | 9.621       |                       |                  |                            |

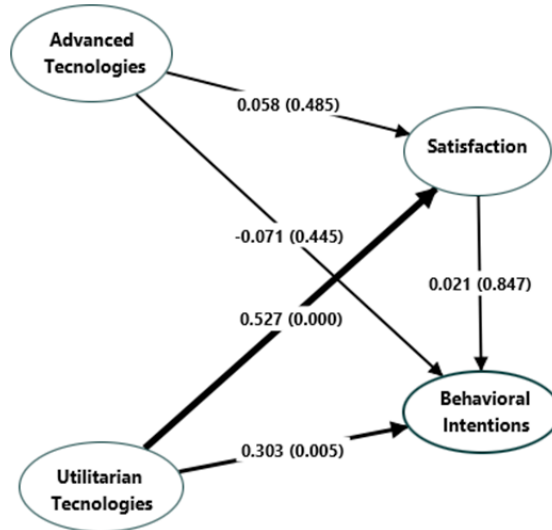
(a) t-values were obtained with the bootstrapping procedure (5000 samples) and are significant at the 0.001 level

Discriminant validity was assessed employing the Heterotrait-Monotrait (HTMT) ratio and the Fornell-Larcker criterion. The HTMT values were below the threshold of 0.85, thus supporting discriminant validity (Henseler et al., 2015). All constructs also satisfied the Fornell-Larcker criterion, as the square root of each construct's AVE exceeded its correlations with other constructs.

The structural model was evaluated based on the path coefficients, explained variance ( $R^2$ ), and predictive relevance ( $Q^2$ ).

Figure 13.2 shows the path coefficients and p-values (in parentheses). Bolded arrows indicate significant paths at the  $p < 0.01$  level. These findings indicate that the use of advanced technologies, such as virtual reality, chatbots and augmented

reality, did not significantly influence satisfaction or behavioural intentions. In contrast, the use of utilitarian technologies had a significant positive effect on satisfaction, thereby enhancing the overall experience. However, they do not have an impact on recommending the destination or on intentions to return.



**Figure 13.2:** PLS Results

The coefficient of determination  $R^2$  measures the model's predictive power. Values range from 0 to 1, with higher levels indicating higher predictive accuracy (Hair et al., 2022). The  $R^2$  of Satisfaction is 0.33, which is a high value, indicating a well-developed path model and that the antecedent variables considered in this study have high predictive accuracy (Hair et al., 2022). On the contrary, Behavioural Intentions  $R^2$  is 0.07, which is considered a weak value.

The predictive relevance values ( $Q^2$ ) are estimated with the blindfolding procedure in SmartPLS and represent a measure to verify the predictive relevance of the model (Hair et al., 2022). The Predictive relevance of the dependent variables was 0.308 for satisfaction and 0.05 for behavioural intentions. All values are higher than zero, suggesting the model has predictive relevance for the considered variables (Hair et al., 2022).

Finally, the Standardized Root Mean Square Residual (SRMR) was used for model validation. The SRMR value of 0.068 fell below the threshold of 0.08, indicating a good fit between the model and the data (Hu & Bentler, 1999).

## Conclusion

Technological integration in wine tourism is revolutionising visitor experiences, from pre-visit research facilitated by data-driven tools to immersive on-site engagements and sustained post-visit interactions through digital platforms. Technological advancements are crucial elements driving the prosperity of businesses in the tourism and hospitality industry, as they enhance operational efficiency and customer experiences.

The findings highlight a predominantly positive attitude toward the use of technology in wine tourism, with limited concerns about its negative aspects. However, more advanced technologies do not impact wine tourists' satisfaction nor their intentions to return or recommend the destination. In contrast, utilitarian technologies have an impact on wine tourists' satisfaction and behavioural intentions. The findings of this study are particularly relevant for wine producers, marketing and communication professionals, and destination managers. They should consider investing in technologies to attract visitors, but it is essential that these technologies prioritise utilitarian functions to maximise their effectiveness. Success is likely to depend on how well technology is integrated into the wine tourism experience.

Although this study provides useful insights into the use of technology in wine tourism, several limitations should be noted. First, it only focuses on a single wine region. On the other hand, the sample is mostly made up of Portuguese tourists. Therefore, generalisation of the results must be made with caution. The replication of this study with other wine regions and a more balanced proportion of wine tourists regarding nationality would be desirable.

Moreover, the model's low predictive power for behavioural intentions suggests that some influential factors may have been overlooked. Therefore, future studies should explore additional factors influencing behavioural intentions in wine tourism contexts.

Most of the technologies considered in this study were very broad and not specific to the wine tourism context. Future studies could look into the role of newer technologies not covered in this study, such as blockchain or AI-driven recommendation systems, and how they might shape wine tourism experiences.

It would also be useful to carry out longitudinal studies to better understand how the use of technology in this sector changes over time. Another interesting direction would be to explore how different groups, such as age or nationality, respond to these technologies, as this could help tailor marketing and improve visitor experiences. Finally, getting input from winery owners and managers about the challenges and opportunities of using new technologies would offer a more complete picture of how the industry is adapting.

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