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Damien Wilson, Réka Háros,
Judith Lewis and Martin Wiederkehr

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How Should We Digitize the Wine Sector?

Damien Wilson^a, Réka Háros^b, Judith Lewis^c and Martin Wiederkehr^d

Abstract

This study provides preliminary insight into the challenges and opportunities present for wine in the process of adaptation to the modern business environment. This study is being conducted within the Swiss wine sector due to the unique characteristics and value of Swiss wine, culture, and the capacity to access key individuals within the Swiss wine sector and its supporting network. These specific features of the Swiss wine sector offer the potential to probe respondents for depth of information on digitization, whilst maintaining more control over extraneous variables that may otherwise impact research results.

This study utilizes the Delphi method for the purpose of investigating the opinions, ideas and suggestions of key individuals in the Swiss wine sector. Each respondent's feedback is being collected for the convergence of ideas and process of implementation. Divergent responses will all be compiled and synthesized, before returning an anonymised compilation to every respondent for subsequent review and comment. Subsequent rounds of this process will continue until data saturation is achieved. The results of this study will be used to prepare a framework outlining the process and scope of considerations in the successful digitization of the Swiss wine sector.

I. Introduction

Defining the scope and procedure in the digitization of wine businesses is a crucial first step in application. This paper seeks to not only define the scope of digitization for wine business, but also envision the ways in which digitization can be applied in order to improve the progress and development of wine businesses in

^a Hamel Family Chair, Wine Business Institute, Sonoma State University, USA.
wilsodam@sonoma.edu

^b Co-Owner, Sfriso Winery, Treviso, IT. reka@sfrisowinery.com

^c Founder, Decabbit Consultancy & Technology Lead, WBA, London, UK.
decabbit@googlemail.com

^d VP, Weinbauzentrum Wädenswil & CEO, Rutishauser Weinkellerei AG, CH
m_wiederkehr@hotmail.com

the modern era. Digitization's scope extends from the generation and diffusion of knowledge through existing and emerging technologies, as much as advances in automation within marketing, viticulture, winemaking and the distribution of wine.

The digitization of vineyards offers the potential to farm more effectively, harvest more efficiently, and to improve control during processing. Digitization also aims to improve the security and timeliness of distribution, as much as assisting generate further appeal, and to increase customer loyalty.

The means in which to apply digitization effectively in wine business is initially being evaluated in Switzerland because of the unique characteristics of the Swiss wine sector. Swiss wine is almost uniquely consumed within Switzerland, offering an ideal research platform with clear delimitations and the potential to exert better control over variables within the study. Further, given that Swiss culture is highly receptive to technological adoption, coupled with Swiss wine being one of the highest valued across the globe, Switzerland makes an ideal environment for researching the means in which wine business digitization can be effectively applied.

II. Research Framework

In establishing the parameters of a digital wine business, four core pillars underpinning the definition have been identified as central in the process of adaptation to the digital environment:

- 1) the Structural pillar
- 2) the Sustainable development pillar
- 3) the Cultural heritage pillar
- 4) the Digital transition pillar

These pillars encompass more than just what wine is or does for people, but also extends beyond the business to identify where it fits within the business ecosystem as a whole. One of the challenges in bringing wine business into the digital era will be the adaptation of offline practices into an online environment. These four pillars were identified as being distinct, yet interdependent components requiring application from an offline experience for wine business in order to be conducive to the digital sphere.

From innovation and research to preserving tradition while still appealing to successive generations, groundbreaking contributions that the digital sphere can bring to wine have been specified and defined in discussion among wine business innovators. The results of these discussions are presented in this paper, proposing the construction of a framework for digitising the four pillars identified by Swiss wine business managers.

This project concludes with the results of convergent themes from the first round of research into the digital wine concept. The key points in convergence are explained, and initial considerations are proposed for a number of directions in which the research may develop. The aim is to convey an outline of the issues considered across the disciplines of production, distribution and sales, and to define priorities for adaptation into digital wine businesses.

The development of this framework will emanate from the need to communicate vini-viticultural traits in a more user-friendly manner, as well as modernising traditional grape farming and marketing practices. These considerations from Swiss wine businesses illustrate both logical responses and pragmatism in practice. Identifying an effective framework for digitisation adoption, and then establishing a practical timeline for implementation are the key components in aid of adapting a wine business to the needs of a digitised business environment.

III. Establishing the concept of the digital wine business

The structure of this research project follows-on from the need to establish a definition of a digital wine business. The process of technological adoption among any industry is then outlined in principle, before being applied to the specific case of the wine sector. The emergent considerations for the wine sector to adapt to a digital framework are then ordered into a series of sequential topics for discussion by a sample

of industry-leading respondents across the global wine sector.

These topics are then conveyed to respondents as part of the Delphi method used in this study. The considerations and priorities for wine businesses are outlined in adopting a digital wine business perspective. The considerations in maintaining an attachment to analogue procedures vis-a-vis adopting digital implementation closes the main body of this summary.

The modern wine industry is facing an unpleasant dilemma. Although wine has attracted more consumers around the world than ever before, many of these wine consumers of today expect wine to be easy to find, consistent in style, and low in price (Carsana & Jolibert, 2017; Mehta & Bhanja, 2017). As globalization has led to the expansion of retail choices through to wine brand oversaturation, consumer expectations are that prices reflect a maximisation of production economies of scale, while minimising all production redundancies. Such goals are nigh on unobtainable, but via the implementation of scientific advances and/or application of technological innovations (eg. The assembly line, UPC codes for automated logistics management).

However, wine may not be as simple a category on which such innovations could be freely applied. On being asked about the use of an assembly line to build new cars, Henry Ford was quoted as saying that "...customers can have any colour [car] they want. As long as it's black!" Ford's reference to the need to produce a car as homogeneously as possible was what helped the assembly line mechanisation of car manufacture accelerate the production and delivery of new cars. With the modern wine sector marked by evidence of continuing fragmentation in wine brands, to say that the wine industry is falling behind competing industries in these aforementioned goals is an understatement (Elzinga, 2011).

IV. Rooted in Place - The Significance of Location

The bulk of wine producers across the global wine sector adhere to the tenets that when consuming a wine a well-farmed product should be able to convey the sense of the product's provenance (McCutcheon, Bruwer, & Li, 2009; Perrouty, d'Hauteville, & Lockshin, 2005). Communicating this 'sense of place' is important to many wine producers, yet the manner in which it is communicated varies across the globe. Some regions have gone to great lengths to identify specific fragments of land that convey varied nuances of sensorial difference. The most prominent example in this case would be France (Contò, Vrontis, Fiore, & Thrassou, 2014). However, other countries are trying different means to communicate collectively, so as to take advantage of a consumer's greater awareness of a larger regional area. A salient example would be Australia's states being used to help communicate a common image of expectation to consumers familiar with such a concept (Smart, 2012). The logic being that an Australian state is a better-known entity for most consumers, especially when compared to some isolated, and idyllic town in a little-known rural region where grapes are grown. Alternative promotional means for locations can be found in other regions producing a common wine style. By linking the specifics of their location with that common style, lesser known wine regions in Spain can build salience through the production of Cava (Chamorro, Rubio, & Miranda, 2015). A topical example where such a process has been successful would include Rosé de Provence in France or Cap Classique in South Africa.

This sense of locality is particularly important to wine producers, and it is seen as a necessary precursor to success. A narrow vision in seeing the producer's location as being the cornerstone of commercial success is one of the driving factors behind the need to understand the challenges facing the global wine sector. Digitising the location where grapes are grown, and facilitating the use of location services for the purpose of navigating to or from a tourism site or vending location, are just some of the options available to those wine producers needing to adapt in order to become a digital wine business. Being able to balance the inherent need to express and reflect the characteristics of where the wine was made, while adapting to the sensorial and commercial needs of the modern wine market drive the need to set a framework for encouraging the traditional wine producer to adopt the appeals of the digital age.

V. Technological Innovation Adoption

The reality of the modern business environment for wine producers is that change is constant. Whether it's a new trellising method in the vineyard or tank shape that accentuates a more fashionable flavour profile,

wine producers are compelled to adapt as the demands of the market evolve. The producer's familiarity with methods in the vineyard or winery mean that innovations of this nature are incremental changes. Such changes are adapted more readily because the change is a minor alteration from within a substantially larger concept of which the producer is already an expert (Latour and Latour 2010). The ideal of a wine digitization being applied as a business run with minimal human intervention should thus be conveyed as not requiring substantial information technology skills, but that such changes can be effected in such a way that producers feel that they are relatively minor adjustments to existing knowledge and practice.

The adoption of technological advances can be a major roadblock in primary industries because of the challenge in countering the expected effort to adopt with a perceived limitation in benefits (Plouffe, Hulland, & Vandenbosch, 2001). However, resistance to adoption has been mitigated by illustrating successful examples among peers (Long, Blok, & Coninx, 2016), and through establishing confidence in the change agent among the audience of potential adoptees (Balta-Ozkan, Davidson, Bicket, & Whitmarsh, 2013). Further, evidence suggests that illustrating the value in updating existing technology, repurposing new technology, and tying them together with what is currently termed a "black box" - a smart technology utilising machine learning to improve farming and vinification techniques - can be effective in communicating that wine businesses with minimal human intervention can evolve from idea to practice.

1. Conceptual Distance – From Farm to Fashion

The disparity between what the wine producer wants, to what the wine consumer wants is a disparity that can be explained through an extension of the idea of conceptual distance (Dekker, 2005; Kodratoff & Tecuci, 1988). Greater distance between two concepts equates to more time required to bridge the distance between them. Cognitively, the traversing of greater conceptual distance can lead to greater ambiguity in interpretation between concept provider and recipient. However, as illustrated by Hocking and Vernon (2017), where greater conceptual distance needs to be covered in problem solving, there is a greater likelihood of finding creative connections.

Additionally, Kodratoff and Tecuci (1988) illustrated that learning is most easily effected through ideas that connect consistently and in a familiar manner in the mind of consumers. Specifically, the greater the disparity between known concepts and those being introduced, the more difficult they are to connect in one's mind.

The implications for wine producers are noteworthy. While wine producers are most familiar with wine and the process involved in making it, the prospect of having to adapt to mechanisation and technology is anathema to most practitioners. Most wine consumers are also physically distant from wine producers and wine regions. The wine consumer knows little about the process of making wine, but is more comfortable with technology and has expectations of the digital era. The conceptual distance between wine production and the digital era is vast, but the process of connecting the two concepts has the potential to link the consumer more closely with the producer.

2. Technological distance

Technology can act as the catalyst in connecting disparate concepts between producers and consumers. Even though the producer is more grounded in tradition and practice, the regular updating and utilization of technology in the vineyard and the winery offer opportunities to facilitate a move for the wine business to readily adapt to digitization. Further, the urban environment, where wine is more commonly consumed, is where the modern consumer retains a regular connection with technology. Finding a means to investigate how to digitize the connection between wine producers and consumers is the primary aim.

Wine producers already use technology across the growing season, in the winery, to monitor inventory and to record operations within the winery. The use of technology in the wine business is for commercial purposes (Aubert et al., 2012; Obai et al., 2013; Swindell, 2016). In contrast, wine consumers use technology to discover, share, and communicate facts, experiences and opinions on wine (Wilson and Quinton, 2012; Wilson et al., 2014). These two sets of divergent usage experiences suggest that a platform for their convergence would be difficult to create. However, inspiration for converging the usage of technology by wine producers through the means in which consumers use it can be found in other

examples. While traditional retail models suggested that farmers would struggle to sell fresh groceries through e-tailing, Ashraf et al. (2014) illustrated that consumers adopted the technology by the fostering of trust through confidence in the platform, and by providing guarantees in service. Further, Moeller et al. (2013) offers insight into such opportunities for producers willing to create services that offer customization and diffusion of wine experiences to networks of consumers. Such opportunities cater squarely to the wine consumer's interest in greater convenience, and symbolic consumption of wine (Charters and Pettigrew 2008).

VI. Forecasting the Outlook for Digital Wine

This study also investigates the potential of the wine sector to adopt technology in order to better cater to the emerging needs of an evolving wine supply chain. Thus, an appropriate method in compiling such a forecast needs to be able to capture expected and sought-after changes across the wine sector. Further, the impact of such change on wine business and the managerial requirements would ideally need to be estimated from the results. Such a research question investigates themes and concepts, requiring the implementation of a qualitative methodology.

Qualitative research methodology options include such methods as documentary studies, interviews and focus groups. However, these methods are best suited for investigating evidence of historic behaviors and opinions. Given the prospective nature of this study, a well-suited method requires that respondents have sufficient time, and opportunities to provide detailed information on their view of the research topic. Further, given the speculative nature of any prospective study, the sampling frame of respondents demands targeting the most knowledgeable experts on wine and business, as well as those with knowledge on the propensity to adopt technology in the fields of production and distribution. Accordingly, these considerations became the key aims in selecting the methodological design (Aubert, Schroeder, & Grimaudo, 2012). The Delphi method was thus selected as an effective tool for this purpose, as it is well-suited to identifying constraints to adoption, and for helping to prioritize those aims that facilitate technological progress (Diamond et al., 2014; Okoli & Pawlowski, 2004).

The Delphi method is a structured research technique that was initially used in forecasting (Linstone and Turoff, 2008). The method is effected by collecting responses from individuals to queries on potential, possibility, probability and the key variables considered important to the study. There are two components of the research method that make it unique. Firstly, each respondent is given time in which to provide their responses to research queries. The second component is that each respondent is subsequently provided with a collective summary of anonymised responses from all other respondents involved in the research (Aubert et al. 2012; Geist, 2010). Each respondent is then asked to provide (any) further responses, based on having reviewed both the collective, and individual responses from all others involved in the study. Accordingly, the Delphi method collects both individual and group responses (Fischer, 1978; Linstone and Turoff, 2008). The outcome is that this method adds a layer of rigour to prospective research methodology through the collective wisdom of each respondent by interactivity of collective responses on each individual's contribution. The conduct of any additional round of feedback can be conducted until data saturation is achieved.

The first stage in implementing the method demanded that a series of topics be outlined, on which each respondent could contribute their outlook. Thus members of the Swiss wine sector were asked to envisage examples of infrastructure, practices and culture for which technology could improve the awareness, perception and value of Swiss wine. Respondents were asked to define potential constraints to development, and how these may change over time. Topics and issues were sought from specifically identified members supplying the local wine sector, as well as those working in grape-growing, wine-making, distribution, finance and administration. The process allowed the compilation of responses on technology adoption from as diverse a group as possible of knowledgeable wine business professionals (Fischer, 1978; Geist, 2010). In this first round of data compilation, experts in viticulture, marketing, operations and technology provided responses to help identify the most suitable sample frame of respondents capable of supplying data for the first round of Delphi responses.

Once all responses have been received from the first round, all data will be analysed for convergence of concepts through triangulation of contribution, and via construction of emerging sequences of ideas (Baxter

& Eyles, 1997; Denzin & Lincoln, 2005; Jick, 1979). At that time, each respondent in the first round will be informed of convergent ideas from all respondents, as well as anonymously providing all other emergent, but non-convergent concepts from fellow respondents (Diamond et al., 2014; Fischer, 1978). Each respondent will then be asked to respond by making further comments, amendments, omissions and/or retractions based on the collective feedback from all other respondents. Finally, respondents will be asked to indicate priority order for every emergent concept. On receipt of these priorities, these final additions will be reanalysed, and the results presented.

VII. Convergent Outcomes

Initial topics for investigation highlighted machine learning in its potential application within the winery, accepting inputs from various data sources, and then using collected data to make calculations for the best use of water, fertilisers, pesticides, and other inputs. Such smart technology of a proverbial “black box” would help propel a digital winery forward with improvements in time management, cost efficiencies, improvements to crop yields and better farming practices, while continuing to produce high quality wines.

Bringing any agricultural sector fully into the digital age can be a challenge. Agriculture has relied on the knowledge of generations of farmers, their skill with the land and their judicious use of water and pesticides, and on the seemingly capricious nature of the weather. These factors seem incongruous with digitisation and yet they are already subject to a variety of technological solutions, offering modern farmers superior ways of monitoring the environment and the health of crops.

Further digitisation of the process from vine inputs, and every step of the way through to the consumer’s glass in tasting rooms, creating efficiencies and improving overall quality is the purpose of the digital wine business. The aim to become successful in the 21st Century is to create:

“A sustainable wine business of minimal human intervention, which is driven by smart technology.”

VIII. The Four Core Pillars, and Contribution to the Digital Winery

Four underlying core principles were identified as being fundamental to propelling the modern winery into the digital age. These four pillars were identified as being:

- 1) Structural changes
- 2) Progress towards fully sustainable development
- 3) Maintaining wine’s key positioning as an important part of [Switzerland’s] cultural heritage
- 4) The marketing and overall digitisation of the process.

Each of these pillars presents significant potential, as well as a number of challenges to overcome.

The digital winery goes beyond the vinification process and simple monitoring. It is a series of interconnected technologies and processes that will help to improve every part of the winemaking and sales process. Starting from utilising soil and weather analysis, through to the process of choosing the best grape varieties, improving farming practice efficiencies, helping to improve vinification processes, and closing the gap between the wine business and an increasingly digital consumer.

The vision of the digital winery is far from a soulless automated winery; instead, there is a vision of a rich, culturally vibrant winery which encapsulates the cultural heritage of the area while employing smart technology to improve everything from yield and taste to alcohol levels and marketing.

1. Structural Changes

Significant advancements have been made within the agricultural sector to introduce efficiencies through technology and automation. While these advancements are welcomed, they are often compartmentalised and unable to work with other technological solutions, or are needlessly complicated. The winery owner needs to not only know the weather forecast, but also the temperature at various spots in the vineyard, overall sunlight levels by plot subsection, soil conditions, levels of fungi and insect activity in the air, and other variables. While the weather, soil and air conditions data are all currently able to be monitored, no

consistent insight based on concurrent measurements is available.

Numerous technologies exist to monitor soil, air, sunlight, temperature, wind speed, and moisture, but nothing currently exists which ties together these technologies in order to help farmers make an informed decision about winery design, water management, fertilisation or pesticide use. The constant state of flux regarding how best to use these resources demands that a proper interface be developed for the purpose of better informing and assisting the grape farmer of today. Thus, we propose to help farmers grow better grapes and become more profitable through the creation of the digital winery.

2. Sustainable Development

One of the pillars of the digital winery is the need to ensure that the farming of grapes remains an active financial, cultural and environmental contribution in perpetuity. The prospect of losing generations of farming experience as a consequence of technological advancement is not only unappealing, but counterproductive to the concept of sustainability. Advancing farming techniques and practices to ensure future generations have a better work-life balance than previous generations is important, as is reducing reliance on chemical fertilisers and more efficient water management techniques. Farming works most closely with nature, and creating a sustainable future for the land - as well as the people who work on it - is essential.

As pesticide and fertiliser use increases, farmers are using the same level of chemicals on all plots, not knowing whether certain areas require more or less except through experience and intuition. We propose to remove this intuitive approach and design a system where pesticides or fertilisers could be deployed only where and when it is needed.

The prospect of being able to better manage the addition of supplements to aid the grape growing and winemaking process as a consequence of need, rather than hope, is one of the key benefits in adhering to the concept of the digital winery. The aim is to employ smart technology to make existing technology work harder and automation work smarter. With these tools deployed, the digital winery will create a healthier environment for the people and the planet, as well as being able to utilise machine learning technology to continually improve both the effectiveness of practice and financial efficiencies.

3. Wine as Cultural Heritage

Wine in Switzerland is an important part of the culture of many areas, as it is in other countries. The digital winery does not detract from this as it is directly reflective of Switzerland's position as a technological innovator, as well as reflecting its substantial wine culture. The digital winery is about taking existing technology and making it better, adding a technologically driven smart element and creating an efficient winery which produces world-class wine.

While it may seem as though technology could make the winery experience less personal and remove the experience of the terroir from the process, it can also serve to enhance it. The digital winery we envision is one where you can view when a drone is scheduled to fly and spray for pests, and where a consumer can watch that same drone fly over the vineyards from their smartphone.

The winery exists within a landscape which can be investigated through pre-prepared videos or immediately through drone-operated cameras, where consumers can learn more about the land it is grown on and the wine they consume. The digital winery facilitates the telling of stories through a first person narrative, enabling consumers to sit with the founder at any time, walk with them through the vineyard and learn about their passion for the wine and the land. Culture can be shared and communicated digitally, and stories can be preserved for years to come. Consumers can join the winemakers for dinner on the terrace without needing to be in the winery, and learn about the importance of wine in the past and well into the future.

Cultural changes always take time to take place, but digital tools can help to speed up the process and demonstrate to the world that digitisation of an industry like wine can preserve the cultural heritage of the product while also bringing it into the modern age.

4. Wine Marketing and Digitisation

Wine marketing has already been digitised to a certain extent - while wine is still sold at the cellar door, and based on the experience people have in the winery, visitors take their love of this wine back to their homes. Effective wine marketers aim to connect with consumers such that when they return home they may seek to buy more, naturally turning to the Internet in order to do so.

Responding to this demand, many wineries have established a digital presence to help market and sell wine online, digitising the sales process. We envision this innovation going even further, bringing the winery to the individual through the provision of a guided tour, seeing the data collected about each wine, watching the progress of the vinification process and possibly even interact with things within the winery such as smart cameras in the barrel room, digitally-controlled lights, and much more.

There are many ways to improve the digital marketing of wine. Some wineries do not currently have a digital presence, meaning that their wines can only be bought directly at the cellar door, severely limiting the potential for growth. By improving the digital marketing of their wine, not only does the winery stand to increase their growth potential locally, but it enables the potential for a global export market through serendipitous discovery. Swiss wine is one of the few industries where the digital presence of individual companies is very limited, thus capping the exposure of Swiss wines to the global market - this has resulted in Swiss wines being a well-kept secret. Through further digitising the marketing of wine, the digital winery stands to bring Swiss wine to the world stage.

IX. Transitioning from Analogue to Digital

The concept of the digital winery is distinct from the historical perspective of wine and the wine industry. It's important to distinguish between wine concepts that should remain in the traditional form, while recognising that digitising specific elements of production and distribution can be essential for maintaining long-term success in the wine business.

Viticulture, oenology and distribution are the three key components in the operation of a wine business. Whereas the distribution component is becoming more and more mechanised, the practice of growing and processing grapes into wine has taken divergent evolutionary directions, based on the philosophy of practitioners.

Grape growers and winemakers would generally agree that scientific advances and the use of technology have greatly benefited the process of growing and processing grapes into wine. However, a subset of modern protagonists have chosen to revert to historical practices, and/or minimising human intervention in the grape growing and winemaking disciplines.

For the purposes of this study, this latter subset of wine producers are considered to be outside of the scope of consideration for the digital winery. For these producers, no technological advancement or initiative could be considered virtuous with respect to the will and passion that an individual has for using naught but nature to convert nature's vinous bounty into the unspoiled ambrosia that is wine.

This summary is thus targeted at the aesthetic architects who wish to liberate the expression of a wine grape beyond the luck imbued by Mother Nature. Humans are recognised as being a population of creative designers - when the right balance between grapes as the raw material, the tools to convert those grapes to wine, and the technological advancements of the digital age unite to offer opportunity to farmers who want to embrace the opportunities afforded the modern wine sector, then it becomes time to discover the extent and limitations of that creativity in the digital winery.

X. Bringing the Winery Experience into the Digital Sphere

The challenge is not in getting wine producers to buy in to the concept of a digital winery, but to convince wineries that objections to the idea have already been dealt with in the process of digitisation. Using outstanding examples of viticulture, the measurement of reflectivity of the light spectrum as a means to gauge ripeness could counter the time-honoured tradition of randomly sampling grapes in an effort to do the same. Grape receival bins and the process of correcting growth estimates could be almost completely mechanised.

Findings to date converge on three key areas of opportunity for improvement which the digital winery could realise:

- 1) Wine production
- 2) Consumer experience
- 3) Business distribution

Although the production side of the wine sector is relatively non-digital, both the adjuncts to the process, and the monitoring of their effectiveness can be digitised. The business side of the wine sector is steadily becoming more digitised as practices both become more transparent and interactive.

Secondly, the consumer perspective on the digital winery - consumers desire convenience over everything, and also view technological advancements as being important. Consumers want widespread access to the Internet, and the capacity to interact with and experience the digital winery in their own unique way. If the wine business of tomorrow fails to consider the appeal and opportunities for interactivity afforded by the digital winery, that business will be won by wineries which are embracing the digital experience and opportunities will be lost.

Finally, distribution and delivery of wine can be further automated, using machine learning to determine appropriate inventory levels for specific times of year, predictive models telling winemakers how much should be grown for the following season, and delivery systems being enhanced by making use of Internet of Things advancements such as blockchain tracking of bottles from winery to the customer table.

XII. Further Research

To date, the concept of the digital winery is primarily an idea, as opposed to a reality. Initial exploration into the idea of the digital winery converges on the idea that digitizing of production processes need to be harmonized with the cultural values of the production region. Further, sustainability emerged as a key issue, as much as the distribution and marketing of wine in the digital sphere. These considerations warrant further investigation through the use of the Delphi method.

In order to advance the concept of the digital winery, foundational changes need to be made to vineyard management and monitoring. By bringing together existing agricultural technologies such as soil monitoring, weather monitoring, irrigation management and digitised vinification processes with new technologies such as drones and integrated satellite imaging that analyses data to provide ideal solutions for the winery, the digital winery can be made a reality.

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