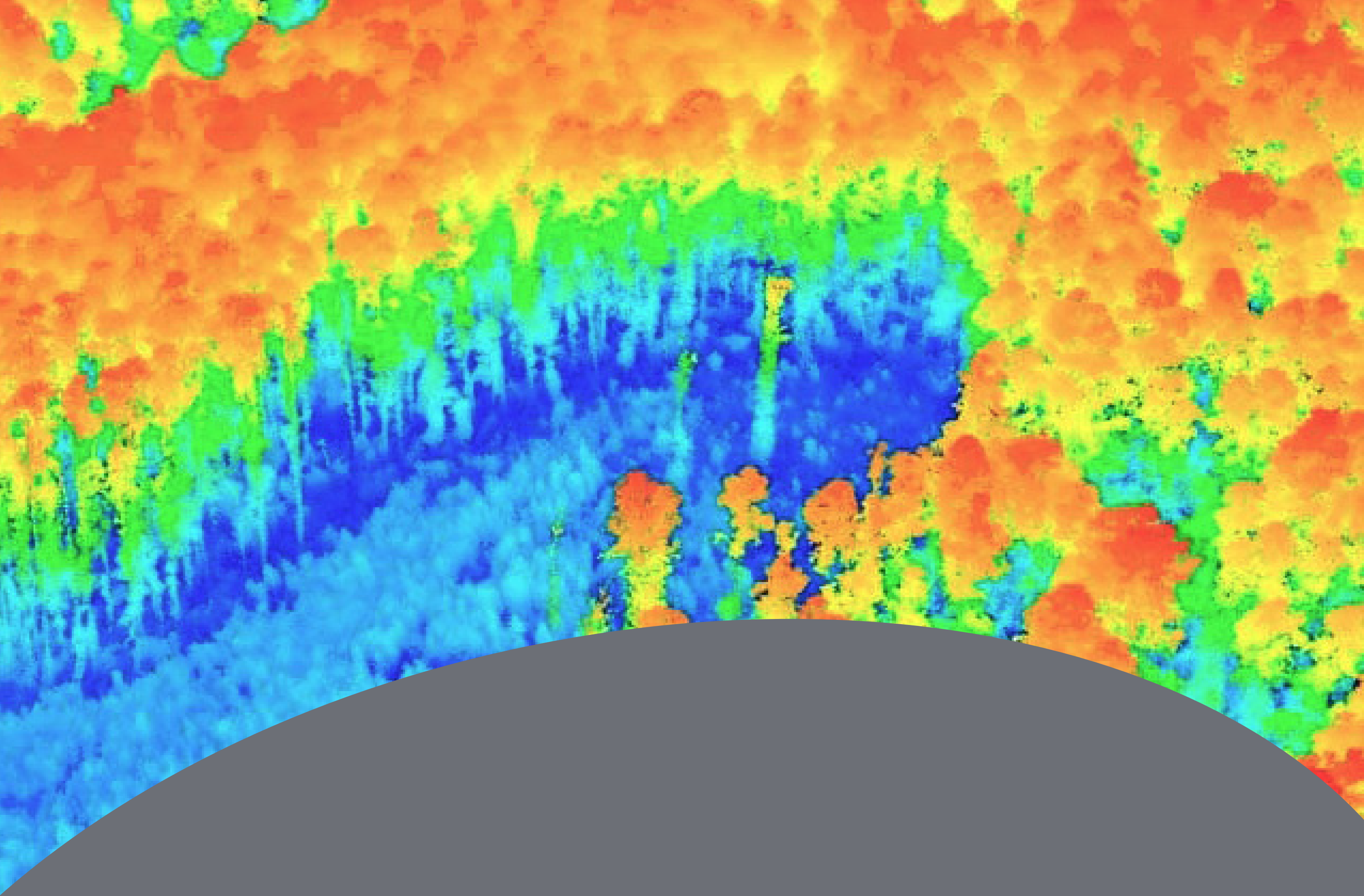
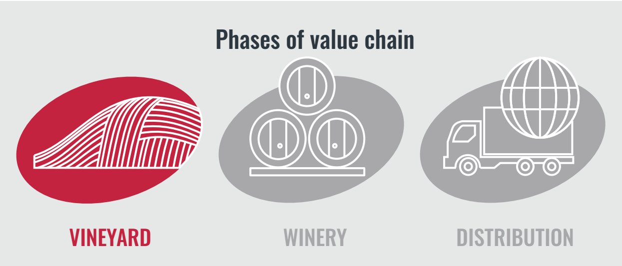


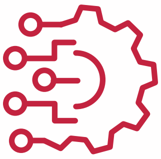
6.5 LIDAR (Laser Imaging Detection and Ranging)

Expert

Alexandre Bastard

He is the head of Research, Development and Innovation of EtOH. After a PhD in Enology/ Biology, he cofounded EtOH, specialised in the digital transformation for the wine, beer and spirits industry. He leads the department of innovative projects and R&D projects with a focus on new technologies and data.





A. The technology

LiDAR (Light Detection and Ranging) is a remote sensing method that can be used to map the structure including height, density and other characteristics of vegetation in a region. This makes it the ideal tool to study the characteristics of a particular area in detail (e.g. terrain, vegetation, obstacles, slope, etc.[4]).

LiDAR is an "active" remote sensing system, which means that the system itself generates energy (light) to measure objects on the ground.

The system emits light in the form of a rapidly firing laser, which travels to the ground and reflects off objects such as buildings and tree branches. The reflected light energy then returns to the LiDAR sensor where it is recorded. Remote sensing captures information -without physically measuring it- about a terrain and records data, which are subsequently used to measure conditions and characteristics.

Where this technology is primarily being used in autonomous vehicles, as it can accurately map the vehicle's surroundings.

In the world of vine and wine, this tool can be used to map the vineyard in three dimensions, from the topography of the land to the fruit of each vine. The "3D cloud points" that are recorded provide an accurate 3D model of a representation of the vineyard. The light emitted by the technology is reflected on the objects it encounters in its path, returns to the sensor and creates the 3D map.

LiDAR was initially used in aircraft. Now it can be installed on drones, tractors and autonomous vehicles. When attached to any of these "vehicles", it can map the terrain perfectly and see in detail the characteristics of the surrounding environment.

Some benefits of this technology include a better understanding of soil properties, improved accuracy of autonomous robots, and improved vineyard technologies with autonomous decision-making models.

[4] Wasser, L. (2020). *The Basics of LiDAR – Light Detection and Ranging – Remote Sensing.* Neonscience

B. Application in the sector

The technology has proven to be effective and many development studies are underway, although it is still not very widespread in the vine and wine sector. Some of the different uses for vineyards include:

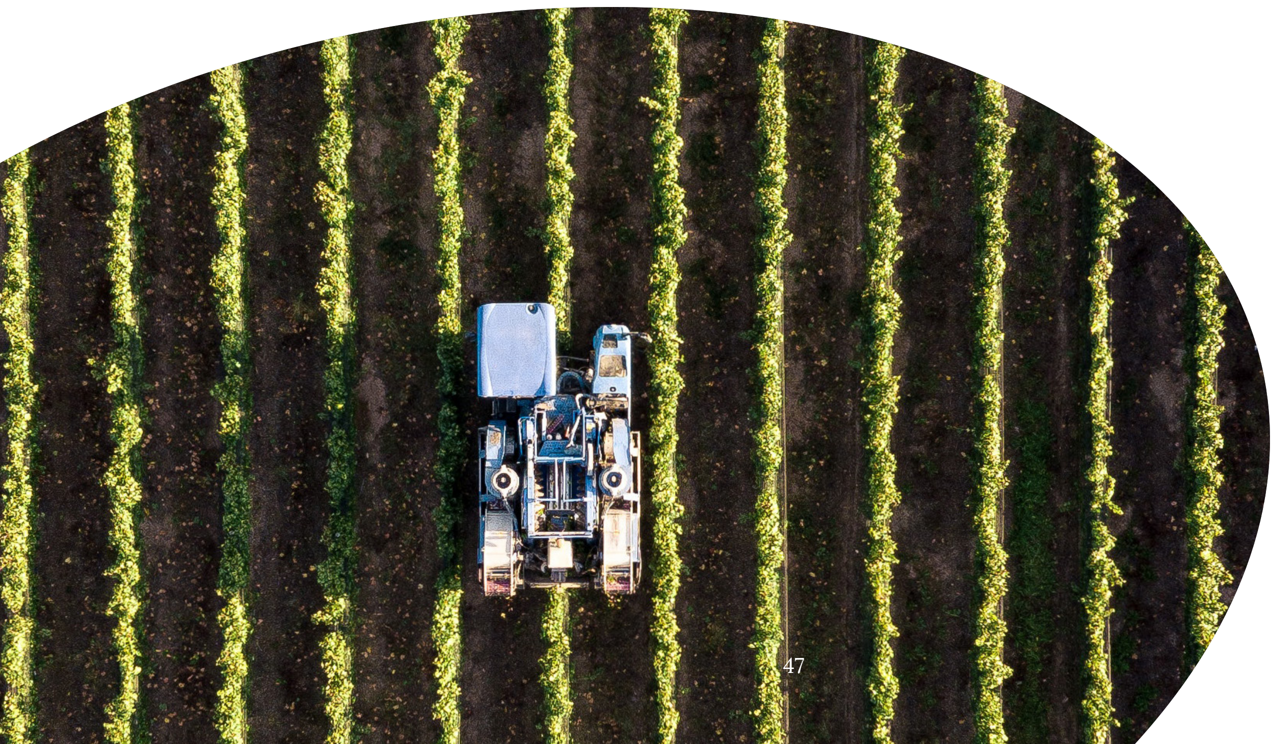
- Harvesting Yield Assessment: as the technology moves through the vineyard, it analyses the areas where there is more fruit and identifies where there is not so much so that other tools, such as fertilisers, can be used to stimulate growth. This way fertilizers and water are used more efficiently.
- Site Specific Spraying: to know precisely which areas have the highest leaf and fruit density. This information can be used to improve precision in the use of pesticides and reduce pollution and costs for the producers.
- Reduce accidents in the vineyard: by having a detailed 3D map of the terrain, the safety of tractors and autonomous vehicles can be improved as the terrain is perfectly mapped with slopes, holes and other kinds of hazards.

C. Technology in the future

In the future, the main user of this technology is expected to be tractor and autonomous vehicle manufacturers for use in agriculture, and so reach the vineyards aboard these vehicles. The technology is expected to be used extensively in crop farming (including vineyards) in the coming years, as it becomes more accessible in terms of cost and adaptability (drones and tractors). As autonomous vehicles continue to develop, the demand for LiDAR tools will rise, resulting in an increase in supply and more competitive prices.

“With LiDAR, agricultural robotics takes a step forward in thoroughness and adaptability. Thanks to its precision, this technology allows robots to better locate themselves and interact with any environment such as vineyards, vines or grapes”

Alexandre Bastard



Smart vineyards

Experts

Antonio Graça

He is scientific-secretary of the Sustainable Development and Climate Change (ENVIRO) expert group of the OIV. He heads the R&D department of SOGRAPE, a Portuguese family-owned wine company, with a strong international presence and unique diversity.

Adriaan Oelofse

He is the Research, Development & Innovation Manager of WINETECH (Wine Industry Network of Expertise and Technology NPC), the South African Industry body that funds and drive research and innovation. He represents South Africa at the OIV Commission II – Oenology group of experts and is also a member of FIVS-STC (Scientific and technical committee).

Mario de la Fuente

He is the manager of the Spanish Wine Technology Platform (PTV), the institution that boots the R&D projects in the viticulture sector at the national or international level.
He also is a researcher in viticulture and oenology at the Polytechnic University of Madrid (UPM) and member of the Spanish delegation of the OIV (MAPA) within the Viticulture Commission, being the Chairman of the OIV Group of experts in vine protection and viticulture techniques (PROTEC) at international level.

Smart vineyards is an agronomic concept that defines the management of agricultural plots based on observation, measurement and action under situations of environmental variability.

This methodology requires a set of technologies that include global navigation satellite systems (GNSS), drones, sensors, satellite and airborne imagery—together with geographic information systems (GIS) and machine learning—to estimate or evaluate and understand these variations. The information collected can be used to not only conduct an accurate assessment of the optimal planting density, but also estimate the right amount of fertiliser or other inputs needed and more accurately predict crop yields and production. This information can also be used by variable-rate technologies (VRTs) to optimise the distribution of seeds, fertilisers, crop protection products and segmented harvest.

Smart vineyards is a type of crop management strategy in which decisions can be made dynamically thanks to the vast amounts of information obtained directly from the field through technologies such as sensor technology or aerial imagery. Farmers are able to improve their decision-making and act proactively on crops by receiving first-hand information directly and in real-time.

These systems provide highly accurate knowledge of the needs and behaviour of crops for a more efficient management of resources and production that can save operational costs and aid producer profitability if applied correctly.

This technology (or new crop management strategy) is now available and is currently being used by farmers and growers in many countries such as Spain, France, Portugal, South Africa, Chile, etc. If properly integrated, this technology can bring numerous benefits and improvements to crops.

The use of resources can be fully optimised owing to extensive knowledge of the soil conditions, plants, luminosity, humidity and other indicators, resulting in significant cost savings.

By knowing the amount of water the plant needs and receives, optimal irrigation can be achieved, saving not only water, but also maximising the productivity of each plant to obtain a higher yield and improved quality.

Smart vineyards bring many benefits such as:

- To aid informed decision making.
- Establish early warning / detection systems.
- Provide suitability tools for climate change readiness.
- Improve sustainable and profitable crop production.

"In the scope of digital transition, and in the grape and wine sector more than in any other sector, one should never forget the principle that technology should serve people and not the other way around"

Antonio Graça

"The wine sector has always combined tradition with innovation, and has been a pioneer in implementing a number of technological innovations in the agro-food sector. However, for innovation to be successfully implemented in the sector, R&D&I must be championed and financed by both the public and private sectors. This is the only way to rigorously test the wide range of innovations on offer"

Mario de la Fuente

"The only thing that is constant is change, so be open-minded, adapt and learn"

Adriaan Oelofse

50

6.6 Blockchain

Experts

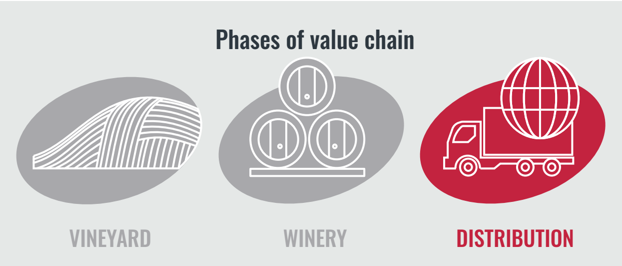
Javier Ibañez

Prof. Dr. Javier Ibáñez, Chaired Professor of Commercial Law from Comillas Pontifical University, head of its FinTech Legal Observatory and co-founder of Alastria Consortium, first (2017) national public-permissioned blockchain DLT network public-private consortium in the world.

Dr. Ibáñez is currently working in the field of DLT networks: Governance of public-permissioned distributed ledgers, token taxonomy, alternative DLT systems for permissioning, and blockchain international legal framework.

Oliver Oram

Oliver's background in financial technology opened his eyes to the potential of Blockchain & distributed ledger technology, which led him to study an MSc of International Management, focusing on fiscal decentralisation, at the School of Oriental Studies. As CEO, he leads Chainvine's team of experts. He acts as a thought leader/smart partner at the Commonwealth Partnership for Technology Management and is an expert advisor at the OECD for the Rural Innovation Group through his work with the wine industry.



A. The technology

As the name suggests, Blockchain is a chain of blocks, which contain encrypted information sent in form of data transactions on the network[8]. Because they are interlinked (hence the word chain), they allow the transfer of data (or value) with fairly secure encryption through the use of double asymmetric-key (public and private) cryptographic encryption, with the notes of automatic replicated data sharing (distribution), ecosytemic consensus, disintermediation, peer-to-peer (P2P) node participation, data privacy and immutability[9].

One of the truly innovative characteristics of Distributed-Ledger Technology (hereinafter DLT) upon which blockchains are based, is that the transfer does not necessarily require a third party to certify the information, through trusted-third parties could be enabled in permissioned blockchains[10] to satisfy legal-compliance requirements. It is instead distributed among multiple independent and equal nodes that examine and validate it without the need for them to know each other. Once information is entered, it cannot be deleted.

Only new information can be added, as the blocks are connected to each other through cryptographic encryption, so it is impossible to modify data from a previous block in the chain, as the information from the previous blocks would have to be modified(11).

Its operation can be complex to understand when explaining the internal details of its implementation, but the basic idea can be easily explained[12].

Each block stores:

- A number of valid records or transactions
- Information about that block
- Its link to the previous block and the next block through the hash of each block—a unique code that can be thought of as the block's fingerprint.

Therefore, each block has a specific and immovable place within the chain, as each block contains information from the hash of the previous block. The entire chain is stored on each node of the network that makes up the blockchain, so an exact copy of the chain is stored by all network participants.

As new records are created, they are first verified and validated by the network nodes and then added to a new block that is linked to the chain. Such chain is replicated in all nodes (node ecosystem), composing the ledger itself (distributed or shared ledger).

As a distributed-ledger technology, where each network node stores an exact copy of the chain, the availability of the information is guaranteed at all times. If an attacker wanted to provoke a denial of service, all the nodes in the network would have to be overridden, since it is sufficient for at least one to be operational for the information to be available.

On the other hand, being a consensual registry, where all nodes contain the same information, it is almost impossible to alter it, guaranteeing its integrity. If an attacker wanted to modify the information in the blockchain, the entire chain would have to be modified in at least 51% of the nodes.

[8] A "transaction" is defined by the International Telecommunications Union (2019), ITU FG DLT,Technical Specification D1.1 *Distributed Ledger Technology Terms and Definitions*, August, Geneva, 6.61, as the "whole of the exchange of information between nodes…uniquely identified by a transaction identifier". In a wider sense, transaction encompasses some kinds of data Exchange composing a contractual agreement executed by Smart contracts (cf. Javier Ibáñez (2018), *Derecho de Blockchain y de la tecnología de registros distribuidos*, Cizur Menor, Aranzadi, 54-64

[9] Ibáñez, ibid., 31-43; cf. Andrea Molano (2019), *Keys to understanding blockchain technology*, BBVA

[10] In accordance with the standards of ITU-T (FG DLT D.1.1, cit., 6.42) and International Standards Organisation (ISO), ISO/CD 22739, Blockchain and distributed ledger technologies –Terminology, "permissioned" means "requiring authorization to perform a particular activity or Activities". Such authorization requires complex offliner or offchain governance and legal policies, approved by the node ecosystem (cf. Javier Ibáñez, Alastria Governance Policies and Ethics, in Ibáñez -coord.- (2020), Alastria Mission and Vision. A multidisciplinary research, Madrid, Reus, 61-76; David Contreras et al. (2020), Validation and Governance in an Alastrian Testnet Node, in Alastria Mission…, cit., 47-60; and incentives for node validation (cf. Pietro Marchionni (2020), Rewarding Honest Validators, ibid. 81-96

[11] *OECD Blockchain Primer*, OECD (2018)

[12] *Blockchain: what it is, how it works and how it is being used in the marketplace*, Cecilia Pastorino, Eset, (2018)

Finally, since each block is mathematically linked to the next block, once a new block is added to the chain, it becomes unalterable. If a block is modified, its relationship to the chain is broken. In other words, all the information recorded in the blocks is immutable and perpetual. In this way, blockchain technology allows us to store information that can never be lost, modified or deleted.

B. Application in the sector

Blockchain technology has a multitude of generic applications. The most common ones, for which most industries or sectors are implementing proofs of concept and decentralised applications and platforms (DApp), are: traceability based upon self-sovereign identity (SSI), smart contracts for legal and economic transactions and tokenisation to create new markets on assets.

Traceability with full sovereign digital identity. It entails the ability to verify or check all the steps that a product has followed throughout its useful life, with in dubious identification of traced objects (i.e. wine bottle, grapes from a vineyard)[13]. This technology allows traceability to be visible and verifiable for everyone, without the possibility of being altered or modified, integrating the ledger as a database wherein agri-food data can be shared by all the participants in the value chain, integrating smart contracts to seek traceability of commercial trade of agricultural assets, and also solutions from IoT on production, to create indelible timestamped proof of current status of the production[14]. Specifically, as far as the vine and wine sector is concerned, this technology allows anyone involved in the life cycle of the product (grape producers, cooperatives, vine farmers, viticulturists, integrated wineries, storage companies and market intermediaries, amongst others) to make all the steps taken by the wine from the vineyard to the marketing stage public. Blockchain records each stage (grape harvesting, production, distribution, etc.), verifying the authenticity of the previous steps each time[15].

- Smart contracts[16] is another of the applications that blockchain technology enables on the corresponding layer of permissioned blockchains. A smart contract is a computer code that allows a contract to be verified and enforced automatically, making it legally valid. People do not need to intervene to check or execute such contracts as they operate on a blockchain, the same mechanism on which cryptocurrencies are based.

  The content of the contract is converted into a code, which is stored in a blockchain. In practice, the terms of the contract are translated into a series of statements and commands that work autonomously thanks to blockchain technology. The code uses the logical rules of programming to ensure that, if certain conditions in the contract are met, the corresponding clause is executed.

  In some cases, it is necessary to involve "oracles" or external agents that verify whether a contract condition has been fulfilled. These IT tools validate the conditions foreseen in the smart contract by using external information to decide whether a clause has been fulfilled or not. When the oracle obtains this information and verifies it, the contract is executed and the planned transaction takes place.

  In fore coming wine-industry integrated digitised solutions, delivery and payments by smart contracts increase the efficiency in credit collection from

[13] Aymo, M. Bellón, C. y Sáenz-Díaz, R. (2020), Smart contracts and decentralized applications in Alastria: the case of Spanish wine, in *Alastria* ence (IEMCON). 335–340. IEEE. DOI: 10.1109/IEMCON. 2018.8615007

[14] Zhao, G., Liu, S., Lopez, C., Lu, H., Elgueta, S., Chen, H., et al. (2019), Blockchain technology in agri-food value chain management: A synthesis of applications, challenges and future research directions. *Computers in Industry*, 109, 83–99; Kim, M., Hilton, B., Burks, Z., Reyes, J. (2018), *Integrating blockchain, smart contracttokens, and IoT to design a food traceability solution.* 9th annual information technology, electronics and mobile communication conference (IEMCON). 335–340. IEEE. DOI: 10.1109/ IEMCON. 2018.8615007

[15] *How smart tech could put a stop to wine fraud?* Matthew Vincent, Financial Times (2019)

[16] Defined by ITU-T FG DLT D1.1, 6.51, as program written on the distributed ledger system which encodes the rules for specific types of distributed ledger system transactions in a way that can be validated, and triggered by specific conditions"; on the concept and enforceability of legal Smart contract see ITU-FG DLT. Technical Report D4.1 Distributed ledger technology regulatory framework, 5.2.3.1, as incorporated (ibid..) by J. Ibáñez as "contract with contract-law structure". While the SC code can self-enforce transactions on DLT-managed assets, other contract terms require traditional enforcement, in particular when its breach requires restitution, when SCs are used pseudonymously or in an international contexts (like wine exports) wherein conventional enforcement is costly and slow

clients and in credit payment to wine suppliers, provided that logistic partners and banks are incorporated by nodes, substantially reducing working capital requirements. Where the terms are payable upon receipt, proof of delivery from a carrier automatically triggers digital invoicing and banking payments [17].

- Another up-and-coming application of blockchain is Non Fungible Tokenisation (NFT). A non-fungible token is a unique token that is generated and legally represents the ownership of a unique product (e.g. a specific bottle of wine, an art peace, a house, etc.) A good example of how NFT works is if I want to sell a bottle, a box, a pallet, or a container of wine. A specific token is created that virtually represents the ownership of that specific good, that is unique, and can be sold, bought or transferred. For example, distributed ledger technology or Blockchain, as it is often referred to, provides suppliers and those within the supply chain better data to track the wine as well as its properties i.e. the source of the wine, its journey and its processing. Having this type of technology implemented within the supply chain means that buyers can instantly obtain this data on the source of wine, its journey, and most crucially of all, its legitimacy. With this intelligent solution implemented on platforms there can be no more doubts on whether the wine is what it says it is. Blockchain gives buyers the power to know that it is. By being able to track the health, wealth, and happiness of the wine, this technology and data tracking has provided a safe means to transport wine and can make this industry one of the safest and most transparent in the world. This can lead to the elimination of paperwork for compliance purposes and the import and export of wine by allowing government inspectors at ports and borders to easily access the data they require for the movement export and import of goods.

C. Technology in the future

When addressing the possible drawbacks and obstacles that this technology is currently facing Mr. Oram pointed out: “*The main draw back at the moment is slow user adoption but I believe this is down to a lack of clear education and perhaps a perception that technology is expensive for vineyards and SMEs involved in the wine trade I believe this will be over come sooner than we believe as more data from companies become available.*”

Mr. Oram also addresses that “*The technology will breakthrough in the next five years and there will be much more engagement or the same as in the early days of the internet. I see we are at the tip of the iceberg and that in the next five years significant scaling of this technology in the wine industry will take place.*” Oliver Oram.

“With the help of blockchain, I would like every producer to know where their bottles are at every moment. The technology is applicable to all kind of wines (no matter its price), and it is just as accessible as all will need access to compliance data”

Oliver Oram

[17] Aymo et al., Smart contracts and decentralized applications...cit., 143

Dr. Javier Ibañez's In-Depth Interview

Prof. Dr. Javier Ibáñez, Chaired Professor of Commercial Law from Comillas Pontifical University, head of its FinTech Legal Observatory and co-founder of Alastria Consortium.

1. What are the main benefits that this technology can bring to the sector?

- Full transaction traceability for consumers
- Fraud prevention in wine commercialisation and distribution
- Enhanced marketability for relevant actors, mainly producers and cooperatives, with effective cross-border cost reduction of wine exchanges
- Material and virtual combined security for transactions on wine and its tokens or digital representations of value
- Speed of legal compliance with administrative burdens
- Fast and secured commercialisation of wine in worldwide token markets

2. Do you see any possible/clear drawback to the application of this technology?

- Political and public-administrative suspicions and/or indecisions; lack of confidence on the resilience or security of DLT architecture or related devices
- Lack of interest of major dominant intermediaries, brokers and distributors, and other monopolistic forces, in public and in private sector as well
- Producers and intermediaries interested in opaque transactions or market abuse (price strangling, informative manipulation, and insider trading...)
- Market factual powers of fraud promoters with respect to wine quality, geographic origin or grape authenticity

3. What could be the bottlenecks faced in the implementation of this technology in the sector?

- Smart contract code implementation
- IoT oracles implementation
- Public-node governance
- Full legal compliance in different jurisdictions with respect to several concerned legal areas
- Private distribution of DLT benefits among relevant stakeholders

4. Is there a sector where it has been already successfully implemented? If so, which one? Why do you think it has been successful there?

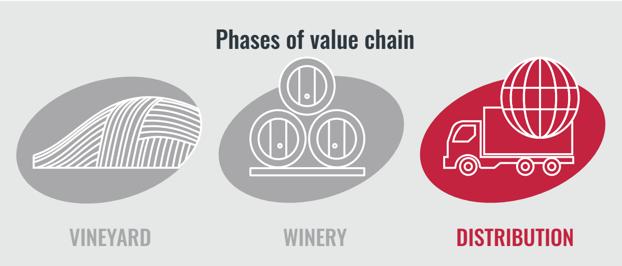
There is not yet a sector wherein DLT is fully implemented, exception made of the financial sector in the field of primary and secondary market experiences in sandboxes, tied to the facilitation of use cases in the framework of the EU financial digital strategy. However, DLT is progressing in parallel within the realm of all main industrial sectors. Bottlenecks do not differ substantially in such sectors.

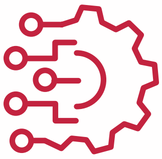
6.7 E-label

Expert

Fabian Torres

He is Principal Business Consultant in SICPA - Expert in Digital Transformation - Guidance Consulting and Advice to Clients in their IT-Strategy, over the last 10 years, implementing the latest cutting-edge technologies.





A. The technology

Electronic labelling (e-labelling) is an alternative and voluntary way for manufacturers to provide a greater amount of information. It has typically been displayed with a physical label that is stamped, attached, or etched on a product. E-labelling means this compliance information is created electronically and displayed on a screen.

Over the past few years, countries, regulatory bodies and local authorities have tended to require manufacturers to display an increasing amount of information on the labels of products. Such information can range from warnings and cautions on the types of materials used and even clinical data, which then also needs to be translated into other languages. Stickers are becoming thicker, text is becoming smaller, and more and more labels are being added. With the introduction of e-labels, the distribution of information within labels has become quicker and more practical.

On the other hand, labels have started to play an increasingly important role in terms of product traceability and security against fraud. On certain products, such as alcoholic beverages, some governments are imposing increasingly stringent measures.

The use of certain certificates of authenticity, invisible or thermal inks, and other mechanisms to identify when a product has been altered or tampered with fraudulently are becoming ever more important and standardised in the sector.

E-labelling affects the last stage of the value chain of wine, namely distribution, providing benefits to manufacturers, regulators and final consumers.

For manufacturers and regulators, e-labelling offers a powerful alternative to the traditional methods of displaying compliance information. This is especially helpful as it enables product design innovation, benefits the environment and protects natural resources. It avoids unnecessary paper consumption and reduces the waste created in the process of producing and updating physical labels.

E-labelling—through QR codes, for example—provides easy access to information and also allows more information to be displayed than on a physical label, and contains all information required by regulatory bodies, while always maintaining security and reliability. QR codes are ideal for the consumer to access from the place of purchase or a restaurant. They are not only able to compile all the product information that is available, but they can also link to videos on experiences related to that specific bottle and grape.

Operational since 2010, several wineries in Spain have accepted the anti-fraud system of the "Centro Técnico Operativo del Vino (CTOV) 5" as a formula to safeguard the prestige of their brand and to offer a safer product. The purpose of the CTOV, powered by SICPA, is to protect the product against possible fraud or manipulation, as well as to improve its traceability. The encrypted and sequential code linked to each bottle is activated when the wine is bottled.

B. Application in the sector

Recent studies[5] show that illicit trade and fraud in the wine and spirits sector is on the rise. That destroys the integrity of supply chains and hard-won customer trust. For more than 90 years, a global provider of security inks as well as secure identification, traceability and authentication solution is helping the industry and governments to battle illicit trade worldwide. In that journey we discovered that it is essential, especially for the wine industry, to merge in one unique solution the material and security features, combined with powerful secure systems to help to control the full value chain to avoid illicit trade and to open a direct communication channel with the client to increase their loyalty.

The use of electronic tags is now becoming widespread. These labels have QR codes that allow the product to be traced from its origin, verifying the product that is being purchased by using a specific type of ink and holograms to prevent counterfeiting and thus achieve greater reliability for the end consumer and avoid illicit trade.

A secure QR code for electronic labels has been developed, shielded with 4 digital layers, one of them based on blockchain, which even allows the tokenisation of wine with bottle-specific NFT (non-fungible token).

C. Technology in the future

E-labels are a technology that, despite already being developed and affordable, still offers room for growth, especially in terms of potential applications and uses. The vast amount of data and information supported by this technology, coupled with its easy access, suggests that it is set to become a mainstream technology in the future. As the use of this technology becomes more widespread, its usability will increase and new functions will emerge. Traceability, cross-selling, and compliance are some of the areas where investment in this technology is being made. Great strides are expected to be made in the short/medium term.

“Thanks to the implementation of E-Label our customers can include more information in their bottles, including media content and this has helped to increase transparency”

Fabián Torres

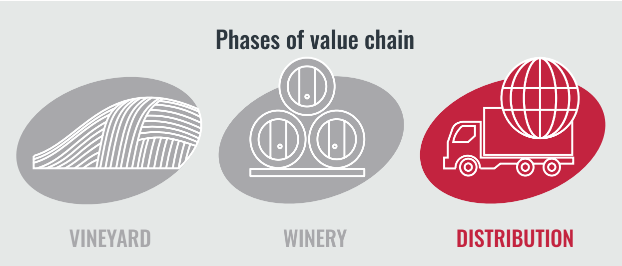
[5] (2021). *E-Label* 4.0. Spain: SICPA SPAIN SLU

6.8 E-certificate

Expert

Glauco Bertoldo

Agronomist graduated from at Federal University of Paraná (UFPR), specialist in fertilizer production and technology at University from São Paulo (Esalq/USP) and specialist in data science from Mackenzie University (MACKENZIE). Federal Inspector of the Ministry of Agriculture, Livestock and Supply (MAPA) of Brazil since 2002.



An e-certificate does not necessarily imply creating a new certificate but it is rather a safer and more efficient way to exchange data throughout the whole life cycle of a product. Exchanging information electronically can offer plenty of benefits compared to the traditional certification system.

Find an illustrative example of the operational model of an Electronic certificate used for international trade.

A. The technology

An Electronic Certificate (hereinafter, E-Certificate) is a set of data that enables (i) the identification of the holder of the certificate, (ii) a secure exchange of information with other persons and institutions, and (iii) the electronic signing of data sent in a way as to allow verification of its integrity and origin.

An e-certificate contains specific information about a product to prove that it meets some requirements and certifies some of its aspects (origin, sanitary, import-export, tax, etc.). The main difference resides in that the certificate is digital, which means that the information is stored in the cloud, cannot be lost or counterfeited and can be accessed from many electronic devices.

Another major differentiating fact is that one e-certificate can contain the information of many different certificates. The same e-certificate can acknowledge the origin of a product, the quality, producer, health certificate, and any other requirement a country or counterpart needs.

Click here to see the video

Currently, the vine and wine sector has no commonly agreed standards for e-certificates, nor does it have any global certificates to simplify the trade of wine between countries or regions.

In the vine and wine sector, some of the most commonly used certificates are the organic certificate, certificate of origin, quality certificate, free sale certificate and environmental certification. At present, all these certifications are managed in the traditional way (i.e. paper certifications that must be passed along from hand to hand just like the products they certify).

Examples of certificates

E-certificates bring numerous benefits to the sector (public or private) they are implemented in. These benefits are spread throughout the entire production chain, from obtaining raw materials to marketing and exporting the finished product. The main benefits for the vine and wine sector are:

- Reduce time issuing certificates
- Improved flow of information
- Improve certificate integrity and security
- Environmentally friendly
- Reduce barriers to trade
- Regulatory modernisation

B. Application in the sector

A successful use case of an e-certificate implemented recently in the sector of fresh goods (plants and flowers) is ePhyto Certificate (an abbreviation for "electronic phytosanitary certificate"). ePhyto is the electronic version of a phytosanitary certificate in XML format.

Since 2011, the Commission on Phytosanitary Measures (CPM[6]) has encouraged the advancement of electronic certification. The CPM-9 adopted the Appendix 1 to ISPM 12. The appendix describes the format and content of electronic phytosanitary certificates and their exchange between NPPOs and refers to harmonised codes and schemes[7].

All the information contained in a paper-based phytosanitary certificate is also contained in an ePhyto. It can be exchanged electronically between countries and the data can be printed out on paper, if needed.

An ePhyto is an umbrella certificate that holds many certificates required in the trading of plants and plant-related products.

As mentioned above, the integration with a central hub helps to organize and classify all the information to streamline and facilitate the trade of these products.

It is even more important in the case of flowers and plants, as they are perishable products and can often carry pests and plagues. By reducing customs clearance times, losses due to product spoilage are minimized and all phytosanitary requirements can be grouped together in an efficient way, thus preventing the spread of pests.

Click here to see the video

[6] The Commission on Phytosanitary Measures (CPM) is the governing body of the International Plant Protection Convention (IPPC)
[7] Food and Agriculture Organisation of the United Nations

C. Technology in the future

Below is an example of how an e-certificate could be created for use in the world of wine. Before creating and implementing a digital certificate, it is essential to have a clear understanding of its intended purpose. Some things to take into consideration prior to the creation of the e-certificate are: the most common or demanded certificates by countries as of day, the sort of information to be included, how to be flexible in the information contained, etc.

To create an e-certificate for the vine and wine sector, three main aspects must first be defined, the functional, technological and financial models.

"Electronic certificates already play a prominent role in facilitating international trade. Wines must follow this innovation"

Glauco Bertoldo

1. Functional model: What certifications to include

One of the first things to determine is the information contained and what current certificates are going to be included in this e-certificate.

It is worth keeping in mind that the e-certificate does not intend to harmonise the criteria under which the countries manage their imports/exports (that is a matter determined by the legislation of each country). It will cover all the information that any country requires, and will set out what documentation needs to be submitted in order to be able to trade with such country.

There are currently many different certificates containing a wealth of information. This makes exporting a complex process, which very often leads to delays, a lack of transparency and problems with the flow of information.

The main difficulty in creating the digital certificate is defining how much information it needs to contain, and the flexibility to integrate all the information required by each of the countries. All this can only be achieved if the information is organised in a predefined and systematic way so that it can be found and accessed quickly and easily.

For exports in the vine and wine sector, some of the most important certificates are:

The fact that the e-certificate can contain all certifications does not mean that all of them are to be fulfilled. It is possible to include only the information necessary to export to a specific country, with the option of adding more information later.

In addition to all the certificates it contains, it will be necessary to add several categories of information relevant to the trade of the products.

2. Proposal to categorize information

- **General information, which contains relevant data of the trade operation**: the producer, importer, exporter, brand name, country of origin, country of destination, quantity, etc.
- **Product details, with information on product specifications**: classification, WCO code, packing information, batch...
- **GI data, which contains info regarding**: Country, national type, international type, product category, name, Geographical indication/appellation of origin (GI/AO)...
- **Analysis results**: This category includes all information related with lab work, product tests, analysis, and chemical specificities of the product: Report of analysis ref. name of laboratory, density, total alcoholic strength,
- **Additional declarations**: This is a slot reserved for all the information that countries may request and which are not included in any other specific category previously mentioned. It also covers any certification or reassurance any official body has granted the product, for example: The <official body> of <country> certifies that the above listed product was produced following the production methods approved in <Country> and is fit for export.

3. Technological model

As mentioned before, a hub stores and classifies all information and certificates, allowing all users to consult any information that has been stored.

There are plenty of ways countries or users can exchange and access the information contained in the hub. Some of the most common technologies used for this are:

- **Application programming interface (API)**: An API(7) is a software intermediary that allows two applications to interact with one another. When an application is used, it connects to the Internet and sends data to a server. The server then retrieves that data, interprets it, performs the necessary actions and sends it back to the user. The application then interprets that data and presents the information in a readable way.
- **It is a standard connection between systems that allows the information to be transmitted instantly.**
- **Point to point communication (P2P)**: In modern computer networking, the term point-to-point telecommunications means a wireless data link between two fixed points. The telecommunications signal is typically bi-directional and either time division multiple access (TDMA) or channelized. The most prominent example of point-to-point communication is a simple telephone call, where one phone is connected with another, and both nodes can send and receive audio.
- **E-mail**: This is a regular system in which the user can share the certification and plenty of other information via standard e-mail. A fast and easy solution does not carry any specific requirements hardware wise. The information is stored and organised in a Hub, and is then digitised in e-mail format to make it easily accessible, shared and interpreted.

In terms of the technological model and information delivery, the countries/users can decide which format suits them best, allowing them to have different formats throughout the whole export process, choosing the most convenient one each time.

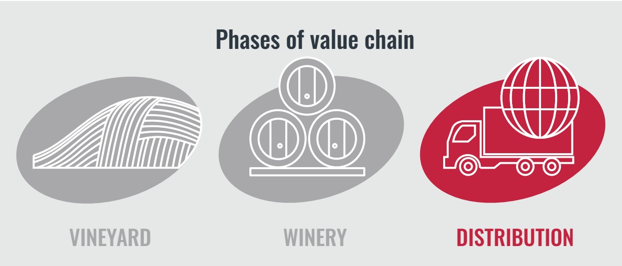
(7) For a simple explanation, **click here**

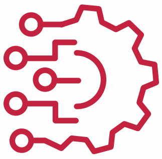
6.9 Smart Storing

Expert

Sergi Almar

Sergi is a partner at Minsait Business Consulting from Indra (one of the world's leading global technology and consulting companies). He is an engineer with an MBA and international experience in business consultancy, focusing mainly on Supply Chain.





A. The technology

Smart warehouses (smart storing) aim to provide efficiency to logistics, helping companies reduce costs and increase product input and output cycles. This is the latest technology used in logistics centres to increase efficiency in processes such as the reception of goods, order preparation and product storage.

With this technology, smart warehouses operate under the control of warehouse management software (WMS). This system directs operators and handling equipment in processes such as receiving or order picking (among many others), to optimise warehouse resources.

The implementation of logistics software is essential to guarantee full control of warehouse stock and, above all, to ensure product traceability in a facility (a logistics attribute increasingly demanded by companies).

This type of warehouse is made up of four key technologies: Warehouse automation; Warehouse management software (WMS) and other applications, such as ERP, SCA/WCS or MES; Radio frequency identification systems (RFID); and Disruptive technologies: blockchain, big data, AI, IoT, etc.

Companies find many benefits with the implementation of intelligent warehouses, as they improve logistics efficiency and allow them to have greater adaptability in the preparation and delivery of orders to the customer:

- Optimisation of warehouse resources
- Increased productivity (increase in picking cycles and storage of goods)
- Availability of a permanent inventory
- Efficiency in order preparation (optimised picking routes)
- Increased fluidity in logistics processes
- Improved safety for employees, storage systems and goods
- Increased storage capacity of the facility
- Logistic KPIs updated in real time
- Total control of the status of the goods
- More accurate demand forecasting
- Automated and comprehensive product traceability

B. Application in the sector

There are multiple applications that, synchronised with the company's ERP, make all processes more efficient.

- The Warehouse Management System (WMS) acts as the brain of the warehouse. It is responsible for coordinating all the processes that take place inside it, from the reception of inputs to the output of orders. By way of example, easy WMS (the Mecalux WMS) incorporates more than 80 advanced functionalities ranging from the management of dispatch routes to cross-docking or wave picking.
- The Warehouse Control System (WCS) is the application that coordinates the tasks of the multiple automatic handling equipment with the WMS orders. It is, therefore, a basic component of intelligent warehouses, as it ensures the correct operation of the entire installation.
- The Manufacturing Execution System (MES) in intelligent warehouses with production lines is the computer system that facilitates the sequencing of production activities, the assignment of tasks to each operator or quality control (of both raw materials and end products).

For example, in a winery in northern Spain, a finished product warehouse automation project was undertaken with robotics. The aims were to: gain flexibility in warehouse operations, improve the service quality for customers, increase the capacity for picking and dispatch of the finished product and boost warehouse productivity by automating tasks and reducing the need for manpower.

To achieve this, the management of the finished product storage areas was automated by deploying AGVs. A robotic palletiser was implemented for the preparation of consignments and SAP's EWM was installed as a management tool for warehouse operations. SAP Fiori provided mobility solutions to simplify the work (use of a camera to read labels, portable printers for operators and sending instructions to the AGV).

Since 1991, a well-known Italian cooperative has invested 42 million euros in technology. A large part of this investment has been allocated to the implementation of intelligent warehouses to increase efficiency in the distribution of its products:

- Warehouse System 4.0 (2018). 14 metres underground to facilitate integration with the territory.
- New fully automated bottling lines in 2018 and 2020.
- 20 new environmentally friendly stainless steel vats, underground (2020).
- Photovoltaic system (2020). 500 KW/hour to power the automated warehouse.

From the empty bottle to packaging and palletising, everything is automated. The way the bottled wines are stored is via trolleys that transport the pallets of boxed wines to a central storage system where a separate mechanical picker is responsible for storing and picking the orders from the various customers and drivers.

This is a large system where the pallets are transported by mechanical trolleys and stored in a large warehouse capable of holding an impressive 7,000 pallets and four million bottles. This warehouse is very large and is one of those innovative storage centres where everything is fully automated, including order picking.

"The main objective that companies seek with robotisation of warehouses is gains in efficiency, resulting in a reduction of costs and greater accuracy in the delivery of products to the customer"

Sergi Almar

[18] Mecalux Esmena (2020), *Smart warehouses: from automation to big data*

C. Technology in the future

This technology is at an early stage of adoption in all sectors, but it is worth noting that a higher level of maturity is reflected in sectors/organisations where there is a high volume of storage and a large number of product references. “*Until today, this type of technology has not yet reached a high level of development in the distribution phase of the value chain of the vineyard and wine sector, but it is true that the demand for these technologies by companies in the sector is increasing and, therefore, we will see a greater impact in the coming years.*” Sergi Almar.

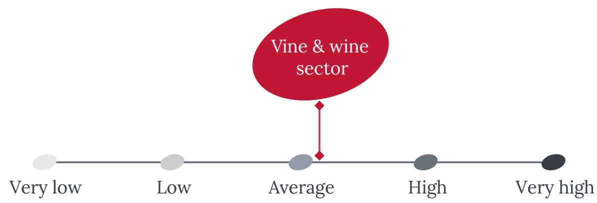
7 Country insights on vine and wine sector digitalisation

This section provides a deeper insight into the state of digitalisation in the vine and wine sector according to experts from OIV Member States. The aim is to know what technologies are more prevalent today, their benefits, maturity level and future of each technology at each stage of the value chain. In other words, this chapter focuses on the progress and impact of digital trends and technologies in the vine and wine sector.

To this end, a digital survey consisting of 8 questions was conducted among experts belonging to 18 OIV Member States. Most of the respondents reported that digitalisation in the sector is at an early stage of adoption. The contrast between the rapid pace of technological development in today's society, and the fact that the vine and wine sector has not yet reached digital maturity, has logically led respondents to expect a strong push towards digitalisation in the short and medium term.

A detailed summary of the answers to the questions concerning digitalisation in the vine and wine sector is given below.

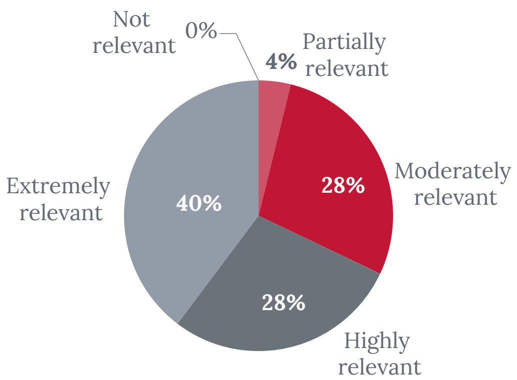
1. **In comparison with the other agro sectors (coffee, cocoa, olive oil...), what is the current extent of adoption of digital technologies in the vine and wine sector?**



The graph above shows that the vast majority of the experts surveyed think that the degree of adoption of these technologies is "average" in the vine and wine sector when compared with other agro sectors. The vine and wine sector does not seem to lag behind other agro-food sectors in general in terms of its extent of digital adoption.

2. How significant do you think the impact of digitalisation will be in the next 5-10 years in the vine and wine sector?

Impact of digitalisation in the next 5 - 10 years / Digitalisation benefits expected in each step of the value chain



It is clear that the respondents acknowledged the relevance of technological developments in the sector in the coming years. According to the data collected, as can be seen from the graph above, 68% of the respondents believe that digitalisation will have a major impact on the sector in the next 5-10 years. Only 4% believe that it will have little or no impact.

3. Currently in your country, how digitalised is the vine and wine sector in each stage of the value chain?

Degree of digitalisation at each stage of the value chain

Most experts indicated that the most digitalised stages in the value chain are the distribution and winery stages. Technological progress has given rise to numerous opportunities in winery and distribution stages of the value chain, which have been possible by technological applications already referred to in this report. The distribution stage shares technological solutions with other sectors, which could explain the higher degree of development. Nevertheless, in the vineyard improvements have been made thanks to technologies such as drones, robotics and autonomous machinery, broad spectrum satellite images, sensorization and other technologies related to smart vineyards.

4. To what extent can each step of the value chain benefit from digitalisation in the next 5 to 10 years?

Digitalization benefits expected in each step of the value chain

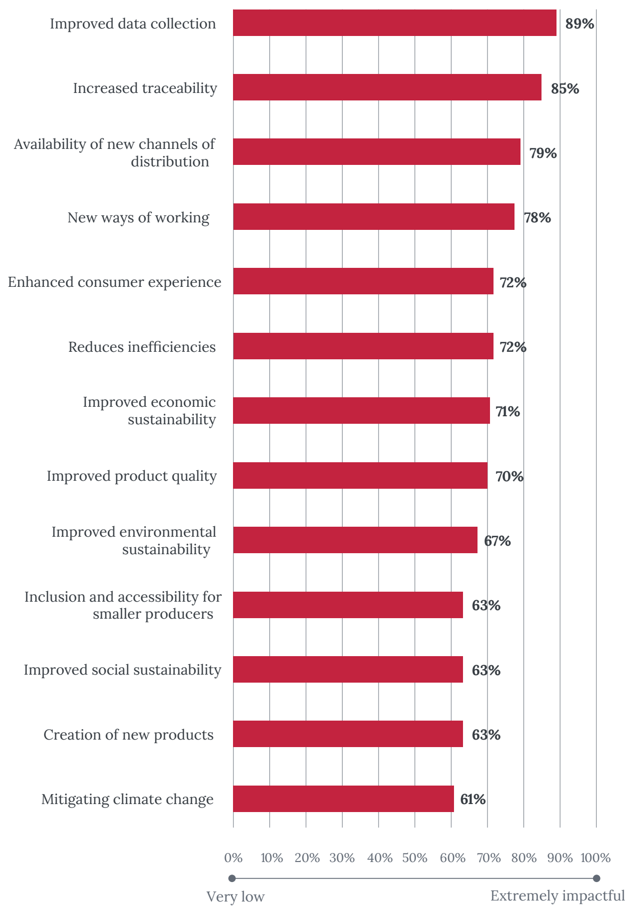
The answers of the experts give an idea on how the vine and wine sector can benefit from digitalisation in the three main stages of the value chain. The distribution stage can continue to increase efficiency and reduce supply costs through the implementation of smart storing facilities capable of automating manual or repetitive tasks.

In the wineries, the application of artificial intelligence and the exploitation of data obtained from sensors placed across production process are expected to increase productivity and provide real-time control over the inventory and the state of barrels.

Robotics and image processing will also contribute to improving vineyard productivity and yield.

5. What fields will be impacted by digitalisation of the vine and wine sector the most?

Future impact of digitalisation on the vine and wine sector

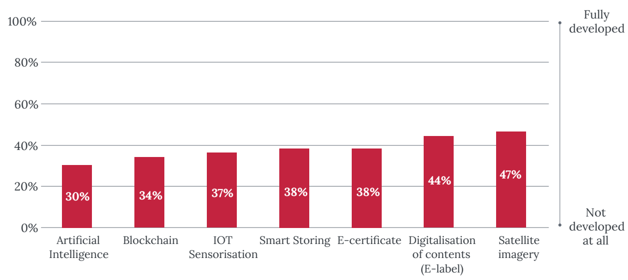


The results reveal that countries expect major benefits from the development of technologies in all aspects of the sector overall. 89% of respondents believe digitalisation will be beneficial in terms of improved data collection (data on quality, weight, grape acidity, etc.) while 85% think it will enhance traceability.

Other effects will include the emergence of new distribution channels, the implementation of new ways of working and the enhancement of the end-consumer experience.

6. What is the degree of development of the following technologies in your country's vine and wine sector?

Digitalisation degree
Degree of development of the following technologies



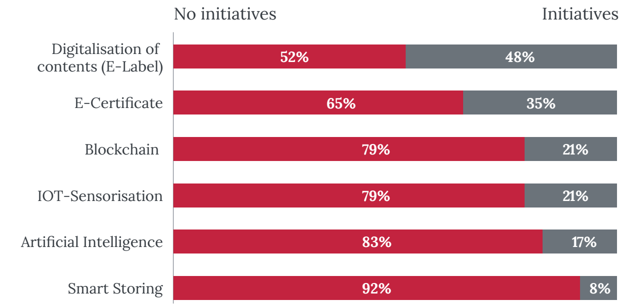
** The score shown in the graph only includes data from regions for which information is available.*

As pointed out in previous questions, respondents consider that technologies still have a relatively low degree of maturity in the sector (an average adoption rate of around 40%). This seems to indicate that the sector's digitalisation process has already started and has the potential for further development in the coming years.

The result of the graph reveals that the technology with the highest degree of development in the respondent countries today is general cartography (satellite imagery/drones...).

7. **Are there any public initiatives (schemes/ support programmes/policies) currently in place in your country to promote the following digital tools in the vine and wine sector?**

Existence of current public initiatives to promote the following digital tools in the vine and wine sector



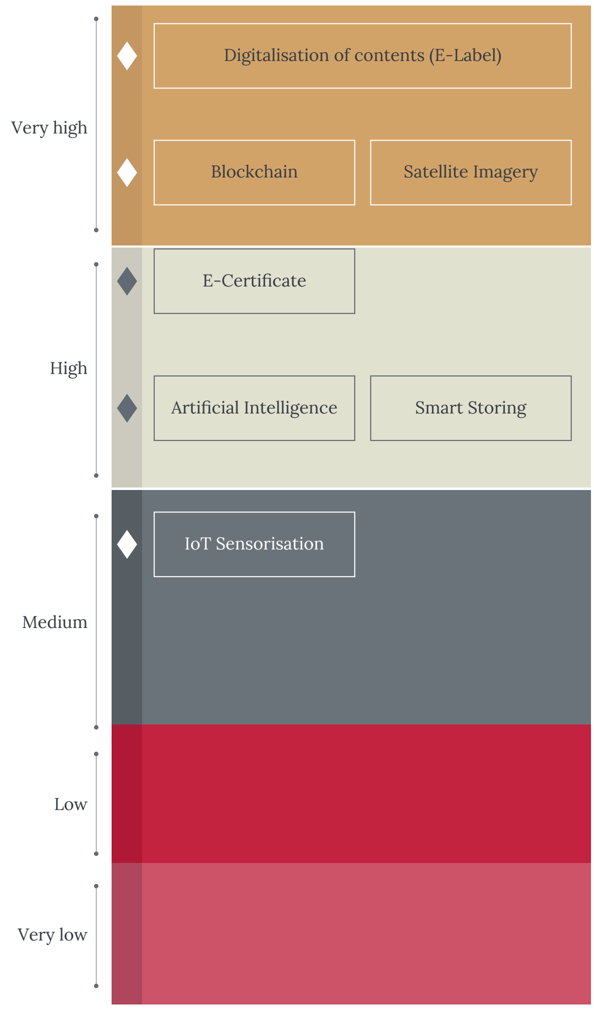
The answers reveal that so far there has been little support in the form of public initiatives to promote digitalisation in the sector. The focus of public institutions seems to have been limited to the digitalisation of contents, regulatory information and processes such as, for example, QR-code labelling (indicating the ingredients and origin of the wine).

According to the respondents, the public sector in some of the member countries promote other initiatives such as:

- The use of artificial intelligence to control insect traps in fields
- The digitalisation of documentation/certifications
- The use of sensors in the vineyard to anticipate possible weather problems (e.g. frost or hail) and optimise the use of phytosanitary products
- Wine producers associations or regional bodies supervising the quality of local wines, who apply a label of quality on wines along with a holographic sticker certifying origin and authenticity.

8. **Which of these technologies should be prioritised for the digital transformation of your country's vine and wine sector?**

Priority Level



The respondents consider that the technologies that must be prioritised first are those capable of increasing efficiency, productivity and regulatory improvements. This is the case of technologies related to the digitalisation of production-related processes or the processing of images obtained from drones or satellites (general cartography). Blockchain is also regarded as a high-priority technology that can improve the traceability of wine from its origin in the vineyard to its consumption by the end consumer.

Other technologies of priority include the e-certificate, artificial intelligence or smart storing, despite of them being at an early stage of development. Other more established technologies such as sensorisation / IoT are held as a medium priority, despite their growth potential.

The survey participants consider that none of the technologies identified should be given low or very low priority.

78

8 Conclusions

The vine and wine sector has now entered into an age of modern digitalisation. Before it lies many opportunities for innovation and a myriad of benefits to take advantage of, such as improved vineyard yields; increased productivity through the exploitation of data using technologies such as artificial intelligence; or the reduction of supply costs by implementing smart storing.

Faced with the opportunities that digitalisation of the sector offers, there are still a number of uncertainties (which technologies to invest in, the difficulty and resources required to implement them and certain risks when making decisions, etc.) that hinder the evangelisation and generalisation of these technologies. This makes it difficult to become a leading sector in the use of these technologies and to adapt to an increasingly technological world.

It can be concluded that the adoption of digitalisation in the vine and wine sector is still at a low maturity level but with a high rate of growth and potential. A significant impact on the sector is expected in the short to medium term (5-10 years). The experts surveyed believe that the level of adoption of these technologies is "medium" when compared to other sectors. While the vine and wine sector is not the most technologically advanced, it does not appear to be lagging behind other agro-food sectors such as coffee, olive oil, cocoa, etc.

There are a number of challenges to be addressed for digitalisation in this sector to reach a high degree of maturity. Some have been identified such as the lack of public initiatives support, the high implementation costs for small producers or the low commitment of end-users.

Nevertheless, as most experts interviewed believe, digitalisation will bring major benefits throughout the different stages of the value chain. These include improved data collection at source (acidity, quality, weight, etc.), aimed at improving vineyard productivity and yield, product traceability, a more efficient use of data to increase productivity, and improvements leading to the introduction of new distribution and marketing channels.

Glossary

1. Artificial Intelligence (AI): machine-based system that can, for a given set of human defined objectives, make predictions, recommendations, or decisions influencing real or virtual environments. (OECD)
2. Blockchain: a blockchain is a shared ledger of transactions between parties in a network, not controlled by a single central authority. You can think of a ledger like a record book: it records and stores all transactions between users in chronological order. Instead of one authority controlling this ledger (like a bank), an identical copy of the ledger is held by all users on the network, called nodes. (OECD)
3. Circular Economy: maintaining the value of products, materials and resources in the economy for as long as possible and minimising waste. (European Commission)
4. Digitisation: the process of changing data into a digital form that can be easily read and processed by a computer. (Oxford)
5. Digital transformation / Digitalisation: refers to a process of adoption of digital tools and methods by an organisation, typically those that have either not been including the digital factor as part of their core activities or have not kept up with the pace of change in digital technologies. (OECD-OPSI)
6. Internet of Things (IoT): the connection of devices within everyday objects via the internet, enabling them to share data. (Oxford)
7. Light Detection and Ranging (LiDAR): is a remote sensing method that uses light in the form of a pulsed laser to measure ranges (variable distances) to the Earth. These light pulses – combined with other data recorded by the airborne system – generates precise, three-dimensional information about the shape of the Earth and its surface characteristics. (National Oceanic and Atmospheric Administration – U.S. Department of Commerce).
8. Technology: scientific knowledge used in practical ways in industry, for example in designing new machines. (Oxford)

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