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Blockchain Applied to Design Systems: Assessment of Quantitative Data on Reports

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Enhancing systemic analysis and environmental verification through blockchain technology in Spanish wineries

Applying the systemic methodology at the winery Bodega Fábrica de Hojalata in southern Spain has established a strong connection between the company and the surrounding territory. The study involved the analysis of qualitative and quantitative data to develop strategic plans that facilitate the progressive development of the company's business. The winery currently relies on a supply of energy from renewable sources for production and internal sustainability. However, the ruggedness of the terrain makes it challenging to use such sources for product distribution. The analysis of the company's workflow has highlighted the difficulties it faces in controlling CO2 emissions during the distribution phase to various European countries. A thorough investigation into compensation options has identified development opportunities for the company, transforming it into a self-compensation project, as well as the possibility of scaling projects to the province and the entire nation. This scaling could encompass wineries and olive groves, where planting has a centuries-old duration. The result generated by systemic designers through business growth planning currently lacks verification regarding the collected data. Therefore, when it comes to ensuring the accuracy of quantitative data, there is currently a risk of incorrect data entry due to the scarcity of available information, compromising its accuracy. This has led to the search for an advanced, decentralised, and global technology capable of securely storing and transferring private company documents and data. The

initial use of blockchain technology is based on notarising reports through a digital platform such as Open Timestamp, which allows documents to be uploaded and receives a unique hash code to verify their integrity. To prevent fraud, it is possible to include the identifying data of the company and the consultant to avoid duplicate uploads. Through a thorough verification of the content of the reports, smart contracts can be used, which have the ability to analyse the data following the input of specific parameters related to the relevant field. The validation process allows for the generation of accessible reports and, in a future perspective, the cataloguing of these reports, which can serve as a model for other production areas and promote connections between local and non-local companies.

KEYWORDS: Peer-to-peer network; Decentralised verification; Sustainability assessment; Blockchain validation; Systemic design; Quantitative data.

RSD TOPIC(S): Methods & Methodology, Policy & Governance.

Introduction

The Company: A Prelude to the Enterprise

Systemic design has gained recognition as a powerful approach to tackling complex challenges by considering the interconnectedness of various system elements (Sevaldson, Jones, 2019). By analysing both territorial and corporate aspects, opportunities for sustainable innovation and the integration of environmental, social, and economic factors are unveiled. In this context, the journey of the Antigua Real Fabrica de Hojalata winery serves as an exemplary case study, showcasing how systemic design principles can drive transformative change.

This Spanish winery, located in the southern part of Spain, in the municipality of Juzcar, is nestled in a natural valley amidst the Andalusian mountains and fully capitalises on its proximity to the Genal River. The winery embodies the values of circularity and reuse, avoiding waste and maintaining a low environmental impact by sourcing electricity from

a wind turbine and a solar panel. The energy generated supports both the winemaking process and the associated agritourism activities.

The winery produces four types of wine within its jurisdiction and employs natural cultivation methods without the use of chemical pesticides, adhering to the principles of historical winemaking. The aim is not merely to maximise production or exploit resources but to develop a circular economy project in collaboration with the surrounding territory, drawing inspiration from the values of the past.

However, choosing to produce according to the tenets of natural agriculture entails certain variations or alterations in the wine types, resulting in the elimination of 15% of the production. Nonetheless, this surplus production is reintroduced in a fully circular manner into the local vinegar production.

The winery's geographical location, surrounded by mountains, allows for the cultivation of fruit trees as well as cork oak trees, from which high-quality cork is sourced for bottling. The cork used for sealing the bottles is of exceptional quality and is not made from compressed chipboard. Moreover, beehives are present, facilitating pollination in the area and providing honey and beeswax. Specifically, beeswax is utilised as an upper protective layer for bottle sealing. Attention is not solely focused on production but also on packaging, as lightweight bottles are chosen to reduce weight during transportation, and serigraphy is employed with biodegradable ink instead of labels to avoid the use of glue and plastic.

Thus, the winery can represent a scalable model for the other 32 local wineries, which could draw inspiration from the Antigua Real Fabrica de Hojalata to enhance their own production and reduce their environmental impact. The only significant environmental impact emitted is the CO2 generated by transportation for export and sale in Spain and Europe. The geographical constraints limit the possibility of low-impact transportation, necessitating reliance on road transport.

Jean Leon and the research team at the Center for Ecological Research and Forestry Applications (CREAF) have conducted studies on the carbon sequestration potential of vine plants. Their research reveals that vine plants have the ability to absorb carbon dioxide (CO2) and act as a crucial long-term carbon sink. Through the process of

photosynthesis, vine plants can capture CO2 from the atmosphere using their leaves. The absorbed carbon is then stored in the trunk and roots of the plants, effectively removing it from the air. Simultaneously, the plants release oxygen, contributing to the oxygen supply and improving the overall air quality. The findings of Leon and the CREAF research team shed light on the additional environmental benefits that vineyards can offer beyond grape production. By harnessing the natural carbon absorption capabilities of vine plants, wineries can play a significant role in mitigating climate change and reducing greenhouse gas emissions. In the pursuit of carbon neutrality, wineries can participate in carbon offsetting initiatives through the use of carbon credits. This process allows for the compensation of CO2 emissions by either investing in existing projects that reduce greenhouse gas emissions or by transforming the winery itself or a group of local companies into entities that create certified Verra or Gold Standard offset projects.

To calculate a vineyard's carbon offset using carbon credits, a comprehensive analysis of the vineyard's lifecycle, energy monitoring, and sizing is necessary (da Silva, Esteves, 2022). This detailed process enables a comprehensive understanding of the vineyard's overall environmental impact and allows for the precise determination of carbon credits generated from CO2 emission reductions.

Once the lifecycle analysis results are obtained, the next step involves registering and certifying the activity with reputable organisations specialising in carbon credit management (Brammer, Bennett, 2022). Examples of such organisations include the Verified Carbon Standard (VCS) (VERRA, 2022) and the American Carbon Registry (American Carbon Registry, 2023), among many others. These entities ensure the integrity and transparency of the vineyard's generated carbon credits through rigorous review and verification procedures.

Upon obtaining certified carbon credits, there is the opportunity to sell them to organisations or companies interested in offsetting their carbon emissions. Specialised online platforms facilitate the buying and selling of carbon credits, connecting buyers with certified carbon credit producers, including those generated by your vineyard. Alternatively, it is possible to utilise the carbon credits to offset the carbon emissions

generated by the company's internal activities, showcasing its commitment to environmental sustainability (Bellassen, Leguet, 2007).

Systemic report generation

Crafting and analysing reports

The reports written by systemic designers are documents that contain analysis, information, and recommendations related to a complex system or process, such as the one being analysed in this case. Systemic designers are professionals who adopt a holistic approach to understanding and addressing problems, examining the system as a whole rather than focusing on individual components or parts (Ryan, 2014). Part of their work also involves incorporating real and truthful data that is not subject to alteration.

Systemic design reports can include various sections, depending on the specific project or context requirements. Some common elements that may be present are the introduction, providing an overview of the system or problem being addressed and the report's objectives. This is followed by an analysis of the context in which the system exists, including the actors involved, social dynamics, cultural norms, and other relevant influences.

Visual representation of the system and the relationships among its constituent elements, using tools such as block diagrams, flowcharts, or concept maps, helps transform the analysis into actionable data (Ryan, 2014). Subsequently, the identification of key problems or challenges afflicting the system, along with an evaluation of their root causes and effects, enables a deeper understanding of the company's difficulties. From there, proposals and recommendations are presented to improve or resolve the identified problems. These recommendations may encompass organisational aspects, processes, technological interventions, or other relevant elements of the system. Finally, essential steps for the project's evolution are suggested.

Systemic design reports are designed to provide a holistic and informed view of the system and its dynamics, facilitating informed decisions and actions to enhance its

efficiency, resilience, and sustainability. However, an increasingly pertinent question arises: Who verifies systemic reports?

Verification process and necessity

Evaluating and ensuring accuracy

The authentication of a document plays a key role in enhancing the security of the information described within it. Verifying and authenticating reports helps reduce the risk of fraud and the possibility of fallacies. The collaboration with systemic designers should strive for maximum transparency in analysing the company and its data. Publishing a report that fails to deliver value is not functional for the advancement of any growth project. Furthermore, ensuring document confidentiality is important for several reasons. First, violating privacy poses serious risks. Personal information in documents can be targeted by malicious individuals, leading to privacy breaches, identity theft, financial fraud, or reputational damage. Second, a lack of document confidentiality can harm organisations. Confidential business information, research, customer data, or strategic plans can be misused by competitors or malicious individuals, resulting in financial losses, compromised contracts, reduced customer trust, and damaged reputation (Antonopoulos, 2022). Non-compliance with data privacy laws can lead to legal penalties and reputational damage. Lack of confidentiality also exposes corporate and personal information to security threats, enabling unauthorised access, cyber-attacks, fraud, and crime (Buterin, 2013). To mitigate these risks, implementing document management practices, access controls, encryption, staff training, and information security measures are crucial to protect sensitive information, preserve privacy, and ensure organisational security (Tapscott, 2016).

Computer validation, supported by blockchain technology, plays a pivotal role in certifying the authenticity and integrity of documents and computer data (Nakamoto, 2008). It offers irrefutable legal proof of document creation or modification on a specific date, effectively preventing subsequent alterations. Computer notarisation is utilised for electronic signatures, certifying digital contracts, establishing the authenticity of digital documents, and determining intellectual property rights (Zyskind, Nathan, & Pentland, 2015). The process involves verifying the identity of parties, ensuring information

authenticity and integrity, and employing encryption and digital signatures. It generates an alphanumeric code that acts as indisputable evidence of a document's authenticity, including the date and time of its creation. As a result, computer validation plays a critical role in ensuring the credibility and accuracy of systemic design reports by providing an immutable and transparent record of their creation, modification, and existence (Buterin, 2021). Unlike traditional validation methods that rely on trust in individuals or organisations responsible for creating the reports, blockchain technology addresses the challenges of human error, intentional manipulation, and data tampering by leveraging decentralisation, cryptographic algorithms, and timestamping mechanisms.

When a systemic design report is notarised using blockchain, a unique cryptographic hash of the report's content is generated, acting as a digital fingerprint and proof of integrity (William, 2016). This hash is then recorded on the blockchain, which operates as a distributed ledger replicated and maintained by multiple nodes in a decentralised network. Once the hash is added to the blockchain, any attempt to modify or tamper with the report becomes virtually impossible without detection. The timestamp associated with the blockchain entry provides undeniable proof of when the report was added to the blockchain. This timestamp derives from the consensus mechanism of the blockchain network, ensuring that all participants agree on the order and validity of transactions or data entries (Swan, 2015). Thus, the timestamp serves as a reliable reference point for verifying the existence and authenticity of the design report at a specific point in time.

By leveraging blockchain timestamping, the validation process of systemic design reports can be streamlined and improved. This approach offers several advantages, including immutability, transparency, auditability, and trustworthiness. Blockchain technology ensures the long-term integrity and authenticity of design reports by preventing unauthorised alterations or tampering without consensus from network participants. The transparency of blockchain networks enables anyone with access to verify the existence and timestamp of a design report, fostering trust and accountability. Blockchain timestamping provides an auditable trail of the report's lifecycle, facilitating the tracking of modifications and identification of discrepancies. Additionally, the

decentralised nature of blockchain eliminates the need for a central authority, increasing overall trustworthiness and reliability (Puthal et al., Das, 2018).

It's important to note that while blockchain timestamping significantly enhances the validation process of systemic design reports, it does not guarantee the accuracy or quality of the report's content. Its primary focus is establishing an unalterable record of the report's existence and chronological order. Therefore, it remains essential to rely on expertise and critical analysis to evaluate the actual design and its suitability for a given system (Szabo, 1997). Another future possibility for validating systemic reports involves utilising smart contracts (SCs). Smart contracts are autonomous computer programs that execute predefined actions when specific conditions are met. Operating within a blockchain network like Ethereum, SCs provide a secure and decentralised environment (Palladino, 2019). Written in programming languages, SCs define rules and conditions for contract execution (Wood, 2014). SCs ensure transparency and trust as they become immutable once published on the blockchain, preventing modifications. However, it's important to note that SCs are not "intelligent" in the traditional sense and do not involve human discretion or interpretation. They strictly adhere to predefined conditions and rules (Antonopoulos & Wood, 2019). Using SCs for document validation enables accurate and transparent verification. A contract is created, defining rules and verification conditions for document validity. The document is uploaded, typically in digital format, and its hash is stored on the blockchain. The SC then verifies the conditions defined in the contract, ensuring the document's validity. All information related to the validation is permanently recorded on the blockchain, ensuring immutability and traceability. Authorised users can access and verify the reports using the information stored in the SC, eliminating the need for third-party verification. SCs automate and secure the execution of digital deals, enhancing efficiency and trust while eliminating intermediaries (Tapscott & Tapscott, 2016).

Conclusion

In conclusion, the Antigua Real Fabrica de Hojalata winery stands as an example of how systemic design principles can drive transformative change in the wine industry. Through the implementation of circular economy practices, natural cultivation methods, and sustainable packaging approaches, the winery showcases a holistic approach to winemaking that recognizes the interconnectedness of various system elements. Additionally, the winery's adoption of renewable energy sources, such as wind and solar power, further reinforces its commitment to reducing environmental impact.

The winery's location in the Andalusian mountains presents unique opportunities for additional sustainability initiatives, including the cultivation of cork oak trees for high-quality cork production and the presence of beehives for pollination and bee wax production. These initiatives not only contribute to the winery's overall sustainability but also create a positive impact on the surrounding environment and local community.

Furthermore, the winery's possibility to offset its carbon emissions through carbon credits demonstrates a proactive approach to mitigating its environmental footprint (Galbreath, 2011). By leveraging blockchain technology for timestamping and verifying systemic design reports, the winery ensures the integrity and transparency of its sustainability efforts, fostering trust among stakeholders and potential buyers of its carbon credits. The Antigua Real Fabrica de Hojalata winery exemplifies the potential of systemic design to drive sustainable innovation and positive change in the wine industry. By considering the interconnectedness of various system elements and embracing circular economy practices, the winery demonstrates how a holistic approach can lead to improved environmental, social, and economic outcomes. The success of this winery serves as inspiration for other local wineries to adopt similar principles and contribute to a more sustainable and resilient future for the wine industry as a whole.

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