Tradecoin report

Introduction

Agricultural food chains are often prone to slowly moving cash flows from the customer to the first farmers, creating social and environmental inequalities. Using blockchain, digital twins and NFTs, it is possible to lower deep tier financing risk and increase social impact.

Initial problem

In our agricultural supply chains nowadays, goods flow a lot more easily from farmers to retailers than money flows the opposite way. A solution to this struggle creating financial, social and environmental stress to farmers and smallholders is deep tier financing. This solution, coming from the much wider supply chain finance umbrella offers the possibility for farmers deep in the chain (as in, the first supplier in the chain, the one that can be found deepest, or the furthest away from the end customer) to have access to working capitals at a low expense, using the credit rating from the buyer. And although this solution is proven effective and used more and more, it is still lacking simplicity and many steps are required for one farmer to receive pre-financing. On top of that, when farmers are willing to make all the necessary steps to get the financing, it can be that some financiers lack trust or confidence in providing the said farmers with working capital. For them, the problem is that pre-financing agri-food goods coming from far away can come with a lot of risks and uncertainties, making the earnings from the financing not really worth it.

Research question

The research question associated with this use case are:

- To what level of detail can we use blockchain technology to track and integrate end-to-end product, information and financial flows of a supply chain?
- How can we use this system to feed a risk assessment model that calculates deep financial deals?
- What is the impact of using those developments on blockchain technologies to:
    - Increase the impact of deep tier finance solutions for the deepest tiered entities?
    - Increase the assessment of social, economic and environmental criteria of all entities in the chains?
- And what additional benefits does an ecosystem-dedicated digital currency have on these pillars?

Developed solution

The project aims to develop an information system that accurately tracks the different transformation process from raw material to finished goods flowing through the supply chain. In other words, it focuses on product transformation activities. Each individual lot of a product (product lot) is represented in each individual state and quantity by a non-fungible token (NFT). Transformations that product lots undergo in the chain are recorded on the NFTs with smart contracts. The value of a tokenised product lot is determined through its product state, weight, location and the transformations it has gone through. The provenance of the product is determined via the entities that had the token in their wallet and which smart contracts transformed the current token and previous instances. The collateral of each supply chain entity is determined at any time through the product NFTs in their blockchain wallets. This approach provides the most detailed tracking and tracing of the supply chain as well as insight into changes in product quantities. Together, all of the product NFTs present in the blockchain form a digital twin, or a copy of the physical supply chain on the blockchain. However, high levels of granularity and detailed tracking lead to many NFT creations and transactions, potentially resulting in high(er) operational costs.

On top of the solution tracking and tracing product through the chain, we developed a risk analysis and monitoring system for the financiers to be able to have a better oversight on their financing deals. The system allows financiers to create product state and location specific risk models, that are applied in risk analyses. Risk analyses are performed on the borrower and its collateral pool before and during the financing deal. These analyses can be

monitored over time to get insight in development of the risk exposure, loss given default, and other relevant risk metrics during the deal.

Developed solution

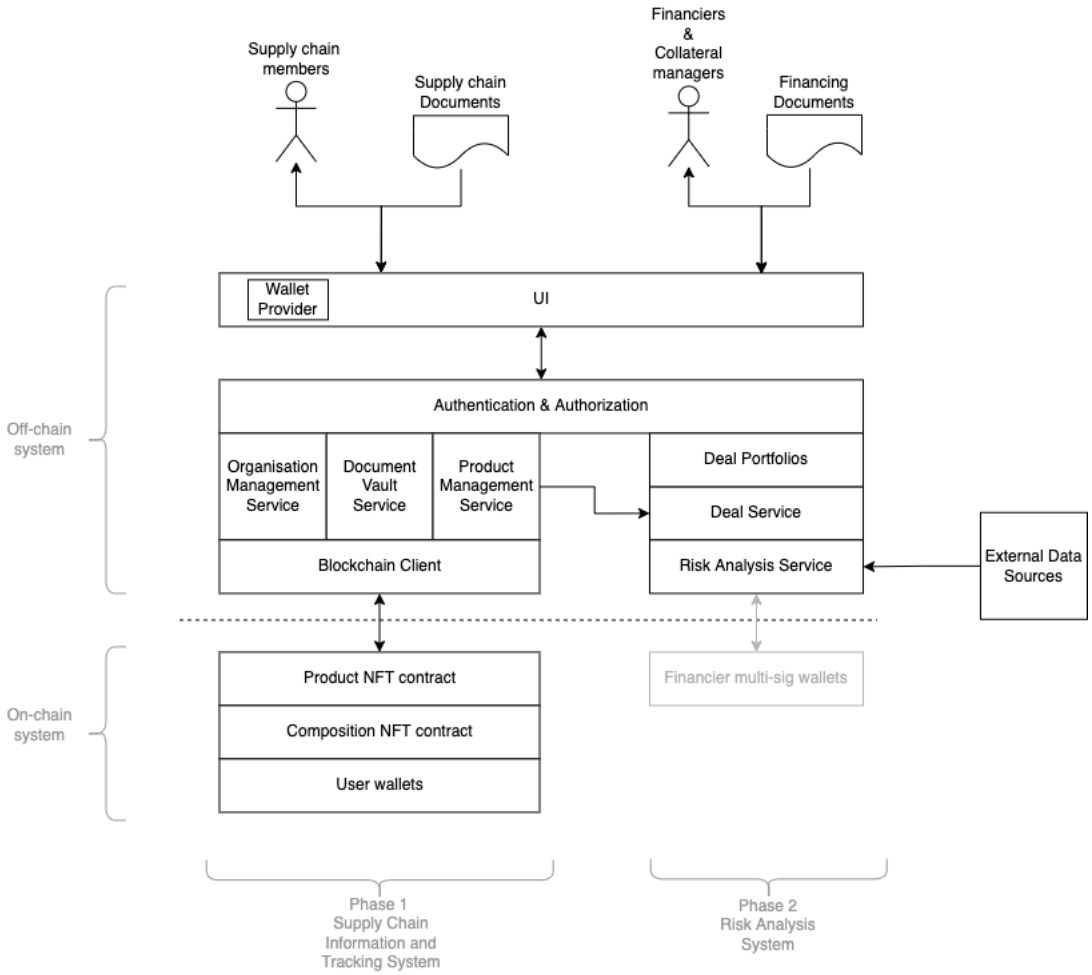
The system was developed in two phases, first the focus was on the fundamental supply chain information system that allows the creation of a digital twin of the supply chain. In the second phase, the risk system was developed on top of this base. Each of these systems consist of an on-chain and off-chain part.

Phase 1: Supply Chain Information and Tracking System

The goal of this system is to capture all product lot related transformations and supply chain actors, events, documents, information, and chronologically connect them to form a detailed product journey. Besides standard components as the user inferface and the authentication and authorization, specific componets were developed for the system to achieve its goal. The system is configured for a specific supply chain via the Organisation Management Service, user accounts are also created and management via this service. In the Document Vault, sensitive supply chain documents, e.g. invoices, transport orders, quality reports etc., are stored and linked to a token and to a file owner. The file owner can authorize other supply chain actors to view uploaded files that he owns. For each uploaded file, the Document Vault also generates a hash - a digital fingerprint of the file - and a root hash – the hash of all file hashes linked to a specific token. These hashes are included in a supply chain event that is notarized on the blockchain, to be able to proof file ownership, origin, authenticity and existence. The Product Management Service collects all the various information pieces from the other services and generates chronological product journeys. The blockchain client functions as interface between the blockchain and off-blockchain parts of the system. The ProductNFT smart contract allows to create new ProductNFTs that represent a single product lot, e.g. a batch of Arabica coffee, or a batch of Cashew nuts. ProductNFTs can be locked in the CompositionNFT smart contract to create CompositionNFTs that reflect a product composition, e.g. a coffee blend, a nut mix, or a machine. And last, the user wallets that contain the ProductNFTs and CompositionNFTs exist on the blockchain, and made accessible via the wallet provider integrated in the user interface.

Phase 2: Risk Analysis System

The goal of this system is to maximally facilitate the financier or collateral manager in modelling, analysing and monitoring of the risk associated with inventory finance deals. The Deal Portfolios Service allows to create and manage a portfolio of inventory finance deals with one or multiple borrowers. The Deal Service allows the financier to create financing deals with one specific borrower, add a collateral pool of ProductNFTs and CompositionNFTs, and perform and store risk assessments on the product journey of each token in the collateral pool. The Deal Service also allows to set alerts on all kinds of risk metrics, that will trigger a notification for the financier or collateral manager. In the Risk Analysis Service, the financier is enabled to create risk models, configured from risk metrics, for each individual state of a product, that will automatically be applied when a risk assessment is performed. It also allows to have input from external sources for these risk assessments. In the future, also a multi-signature wallet will be developed for the financier to have additional control over the collateral of a financing deal. At the start of the deal, the financier and borrower configure the settings of the wallet, meaning that they decide which product actions a borrower can perform by himself or when the signature of the financier is also needed for execution. With these default settings the wallet will be deployed, but later a one-time or permanent change can be implemented if both parties agree.



Findings

While it was the last use case we started, it certainly is one of the most successful we had the chance to have within the Spark! LivingLab. In just six months, we put together a feasibility study, a Proof of Concept description and made several demo's to the end customer, fine tuning the general look and features of the application on the way.

Then, what was remarkable with this use case is that the commitment and involvement of the customer. Not only was the customer available but he was willing to work with us on the prototyping, giving shape and life to the application every time we met. This made the work of the developers a lot easier, making feedback loops a lot closer.

This advantage also brought an inconvenient: the involved customer not only helped us shape the use case as we went, he also shaped his idea of the use case as we went. This made for some heated discussions between the head of our developers and the customers were either side seemed sometimes to be fighting for their ideas. Here, a key factor to enable the group to move forward together was a lot of time and conversation, making sure that all sides were seen and all significant learnings taken.

Finally, with the direct support of an experienced development team, we were able to move forward with a lot more confidence than before. Needless to say, this enabled us to move forward with a lot more confidence than before. They always came with the right questions and always made significant progress during each sprint.

Regarding the relevance of the blockchain on the studied topic, we have yet to find out its actual veracity. Because of the project's time constraints, we were not able to execute the planned pilots. For the first pilots - executed in autumn - actual field data will be used to test the system in shadow mode (in parallel of a real running deal). The tests will tell us very soon how useful blockchain is here and hopefully we can finetune the features to make them more fit to the needs of the field.

Future work/Recommendation

This use case is still active and has a lot of potential based on customer feedback and interest we have received in the last months, so we haven't reached an end state yet. Our current status is that the use case is growing, some might even say that it is snowballing. Indeed, started at the beginning of 2022 with just one application - the pre-financing of deep tier farmers, as described above - this use case is getting more and more interest from various parties and fields. A major actor of the construction industry for example has shown interest in using the foundation of this use case to create a circular economy market place, using the tradecoin system to prove the origin and quality of the traded materials. Another logistic party involved in storing and shipping of goods also wants to use the model, but this time just to track and trace their products more accurately, and to enable a more trustworthy open system financiers could be willing to invest in. Experiments and pilots are currently being planned and will be run in all of the above mentioned cases in the coming months.