

TradeCoin – Proof-of-Concept project description

1. Introduction

The goal of the TradeCoin project is to both **lower the deep tier financing risk**, and to **increase the social, environmental and economic impact for deepest tiered supply chain participants** in agricultural supply chains. Both goals are expected to be achieved by increasing the supply chain visibility and traceability, that allows for more financing options, and thus social impact, for the deepest tiers of agricultural supply chains.

The objective is to develop an information system that accurately tracks all sorts of value-adding transformational activities for raw materials entering the supply chain. Information extracted from the transformational activities is used as input for a supply chain finance risk model developed by the client. The information system will be tightly integrated with the financial flow to provide capital for deep tiered supply chain participants, in a direct, real-time manner.

The goal of this proof of concept is to prove the technical feasibility of the TradeCoin project and to provide a test implementation to perform experiments with. Once the PoC has proven itself, conclusions and limitations can be drawn towards business viability and implementation, but that is out of scope for this project.

2. Research question

To what level of detail can we trace and integrate end-to-end product, information and finance flows of a supply chain using blockchain technology?

How can we use this system to feed a risk assessment model calculating deep tier finance deals?

What is the impact of using those developments running on blockchain technologies to:

1. Increase the impact of deep tier finance solutions for the deepest tiered entities?
2. Increasing the rating of social, economic and environmental criteria of the all entities of the chains?

And what additional benefits does an ecosystem dedicated digital currency have on these pillars?

3. Envisioned solution

3.1 Option summary

For supply chain tracking and tracing there are various ways of implementing blockchain technology as part of a solution. For this project, we proposed three different options, each with its own level of blockchain interaction.

Option 1 - Transformation activity tracing

This option focusses on the product transformation activities. Each individual product lot of any state and amount is represented by a non-fungible token (NFT), that undergoes a number of transformations in the supply chain that are represented by smart contracts. At each transformation, the old NFT is burned and one or multiple new ones are minted to represent the new product state and weight. The value of an NFT is determined via the product state, weight and transformations it went through. The product provenance is

determined via the entities that held the token in their wallet and which smart contracts transformed current token and its preceding instances. The collateral of each supply chain entity is determined at any time via the product NFTs inside their blockchain wallet. This approach allows for the most detailed supply chain tracking and tracing and also for altering product amounts. However, high product granularity and detailed tracing lead to many NFT mints and transactions, resulting in high overall operational costs.

Option 2 - Product lot tracing

Instead of product transformation activities, the focus of this option is on product lot tracing. A product lot of fixed amount is tokenized as an NFT, and is tracked and traced as it flows through the supply chain while remaining largely intact. This NFT is updated via smart contract that represent product transformation processes, and is owned by blockchain wallets that represent supply chain entities.

This option offers less tracking and tracing detail than option 1 because it focusses on a fixed amount of product that remains largely intact along the supply chain. The inability to support altering product amounts leads to less NFT mints than option 1 and therefore entails less operational costs.

Option 3 – Data notarization

In this option, the value, ownership and digital currency components enabled by blockchain technology are completely removed. This option uses the blockchain only as a notarization tool where hashes of original supply chain data are registered with a timestamp. This option has the least amount of blockchain interaction, and is therefore the lowest in operational costs. However, this option only lets an entity register the state of the supply chain, or product, in the form of a hash on the blockchain. Only the entities in possession of the underlying data can regenerate the hash, and compare and verify it to what has been notarized.

3.2 Option picked definition

Option 1 is selected to be developed in this Proof of Concept project, because it offers the most tracking and tracing detail, and the most flexibility regarding product amounts, side stream tracking, and general applicability. Ways to mitigate operational costs will be considered along the development of the solution.

The solution shall be developed in three phases. In the first phase, a blockchain based infrastructure is being set up that allows to create a digital twin of the transformational activities. Products of any type, state, size or amount are represented by non-fungible tokens (NFTs) and smart contracts will transform the state of those NFTs to mimic the transformation processes happening in the supply chain. On top of that, the supply chain document trail shall be digitalized and safely stored in an off-chain document vault. Combined with the blockchain enabled digital twin, a rich real-time data flow becomes accessible for supply chain finance risk assessment. This system also allows for optional direct and real-time financing and payment in digital currencies, since physical product is represented by NFTs that can be bought with digital currencies.

The second phase is to develop a data model that captures the data from both the blockchain system and the off-chain system, and feeds in correctly to all required inputs of the finance risk model.

In the third phase a supply chain ecosystem dedicated digital currency “TradeCoin” will be developed. The goal of this currency is to create a closed ecosystem for the supply chain that offers additional benefits for supply chain participants and offers more supply chain control for the client. TradeCoin has to be stably pegged to a fiat currency for it to be of value in this ecosystem.

An overview of the Proof of Concept development phases:

- Phase 1: Supply chain information system that allows for real-time end-to-end tracking, tracing of value-adding transformational activities, optional payment in digital currencies
- Phase 2: Development of data model that feeds the financing risk model
- Phase 3: Development of TradeCoin and design its ecosystem

4. Use case criteria

4.1 Addressing complex organizational network problem

Organic agricultural supply chains across the globe are made of multiple entities usually falling under the definition of farmer, processor, producer, manufacturer, wholesaler, distributor or retailer. Due to the length of the chains and the multiplicity of entities and process steps, it is often easier to transfer products from farmer to customers than it is to transfer money the other way around. One way to solve this is deep tier finance, giving access to finance for farmers and smallholders at the very beginning of the chain. And if this solution is promising, it also comes with its share of risks for the entities involved in the deep tier finance deals. Developing such a solution could enable not only for the product, information and finance to flow more seamlessly through the chain, it would also enable for a better measurement of the chains’ impact criteria's and therefore of actions to be taken improving those criteria.

4.2 Involvement of SMEs

Across the entire chain, multiple entities take a role in transferring the products from the farmers to the customers. Deep tier finance directly connects trading organizations with farmers or smallholders which are mostly SMEs. And like in most cases, getting access to finance is not an issue for big entities of those chains, such as retailers or distributors, but it can be a lot more difficult for farmers and smallholders to get access to finance. Tradecoin aims to use the power of deep tier finance combined with blockchain to enable the development of those small parties.

4.3 Contribution to circular economy and/or sustainability

All of the chains studied in this use case will be organic, therefore pushing forward a type of agriculture more respectful to the environment, following labels corresponding to the chains. On top of that, giving access to finance to farmers and smallholders will enable a development of production practices, enhancing social, environmental and economic aspect of those entities. An assessment at the beginning of the financing deal will enable an accurate measurement of the impact that the blockchain solution had on the participating entities. Finally, more insights on the steps of the chain will make it possible for broader chains improvement, making it possible in a later phase to develop the studied chains in a more circular way.

4.4. Potential global adaptability

The issues of access to finance from farmers and smallholders isn't an agri-food-specific struggle. It is a problem in all chains having multiple entities and process steps. Developing such a solution will create a benchmark for all global supply chains to make product, information and finance flow more seamlessly across the chain. Furthermore, making the tracking and tracing of all added value activities possible could in itself become a model for all supply chains across the globe to chain their operation methods.

4.5 Contribution to Top Sector action lines

The creation of an ecosystem with a dedicated token to facilitate deep tier finance could contribute to these action lines of the Topsector Logistiek:

- NLIP: by exploring and implementing open standards for data exchange
- Synchro modality: by connecting various entities of a same global chain on the same shared ledger
- Cross Chain Control Centers: by tracing and tracking all added value process on the ecosystem together with the relevant information and finance exchange
- Human capital agenda: by enhancing the reach of supply chain finance, Tradecoin could have a real impact on the deepest tier of the organic agricultural supply chains
- Supply Chain Finance: at the core of the project, Tradecoin is based on the facilitation of deep tier finance for agricultural supply chains

5. Scope

A separate scope for each of the development phases is defined in this section. The phases are additionally clarified in the figure below.

Phase 1 – End-to-end product transformation activity tracing

Goal	Enable end-to-end track and trace capabilities for agricultural supply chains to increase their visibility
Scope	<p>Development of a blockchain based system according the envisioned solution and define ways to implement it in real supply chains. The system includes:</p> <ul style="list-style-type: none">• A user web interface that supports:<ul style="list-style-type: none">○ Various supply chain participants roles○ Tracking and tracing of product transformation activities and individual product lots○ Management and digitalisation of supply chain documentation; such as invoices, warehouse receipts, transport documents, inspection reports etc.• Smart contracts that are able to create or destroy tokens that represent batches of product of varying commodity, weight, state (tokenization, end-of-life contract)• Smart contracts that are able to represent all sorts of product transformation activities happening in the supply chain (batching, splitting and product transformation smart contracts)• Smart contracts that are able to represent all sorts of non-transformational activities, such as trading (commercial transaction contract)• Smart contracts that allow for differentiation between legal product owner and physical holder, and allows for the holder to notarize value-adding activities to the tokenized product (custody contract)

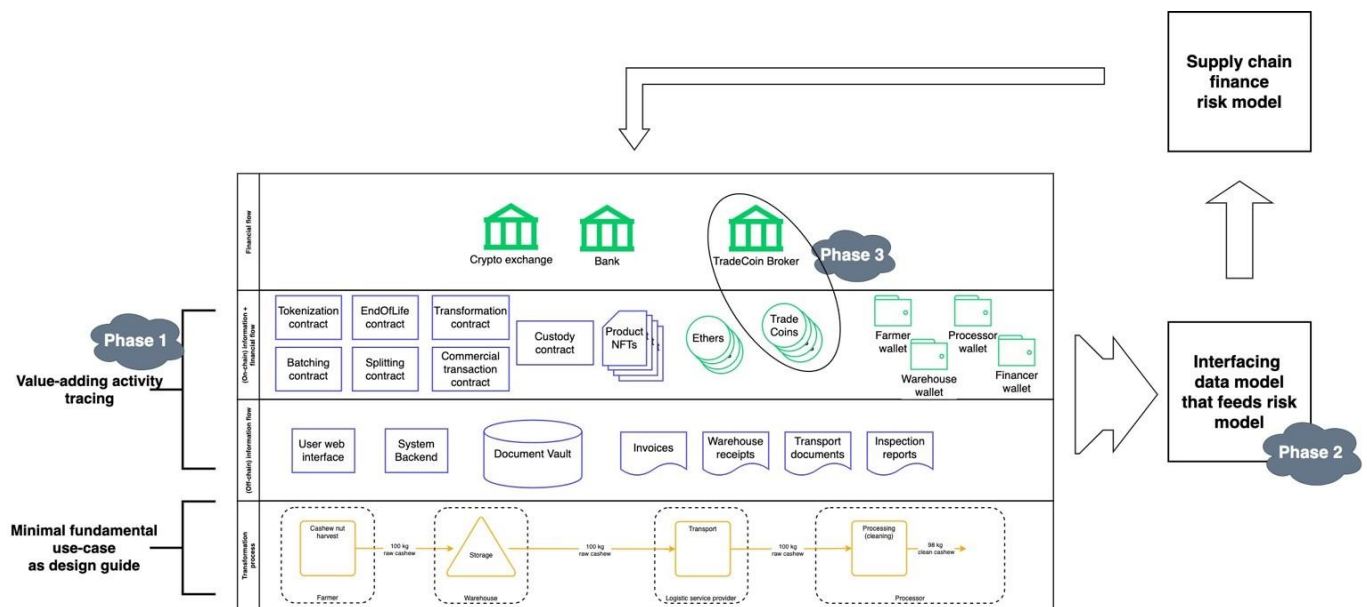
	<ul style="list-style-type: none"> • Non-fungible tokens (NFTs) that represent batches of product varying in commodity, weight and state • A non-blockchain (“off-chain”) system that supports and integrates all of the above, including a document vault for safe storage of original digitalised supply chain documents
Experiments	<ul style="list-style-type: none"> • Mimicking actual supply chain flows and determine impact of system on physical supply chain processes • Evaluate the accuracy, latency, granularity of activity tracing and tracking • Evaluate impact and benefits of tight integration of the information and financial flow enabled via blockchain
Deliverables (June 2022)	<ul style="list-style-type: none"> • System architecture design • Value-chain modeling toolbox? • Codebase for Ethereum testnet implementation • Experiment results • Dissemination

Phase 2 – Data model to feed finance risk model

Goal	Enable seamless information flow from Phase 1 system into Client’s finance risk model to enable accurate risk assessment
Scope	<p>Development of data model that is integrated into Phase 1 system, that includes:</p> <ul style="list-style-type: none"> • Definition of inputs and their measurement methods as required for the risk model • Extraction of essential supply chain information from the blockchain and document vault components of Phase 1 system • Transform extracted information into right format for finance risk model • Continuous real-time information feed for the inputs for the finance risk model
Experiments	<ul style="list-style-type: none"> • Test accuracy and risk model input coverage
Deliverables (June 2022)	<ul style="list-style-type: none"> • Data model design • Test results

Phase 3 – Supply chain ecosystem digital currency “TradeCoin”

Goal	Create a stable digital currency to set up a supply chain ecosystem with and determine its implications and potential services that could be attached to it
Scope	Develop an Ethereum blockchain (ERC20) based digital currency, stable enough to be used for payments in an enterprise setting such as the Phase 1 system; and research towards the tokenomics of such a currency
Experiments	<ul style="list-style-type: none"> • Test stability of currency for different operation scenarios • Stakeholder interviews to evaluate adoption of such a currency? • Demonstrate and test its usability in Phase 1 system
Deliverables (Undefined)	<ul style="list-style-type: none"> • Token design (tokencontract) • Tokenomics (research results of the factors that impact the demand and supply of the token) • Conclusions on supply chain benefits and possible offered services



6. General considerations

- Differentiation between legal owner and holder
 - One method is to require a 3rd signature for transformation processes
- Off-chain data stored in the Document Vault has to be accessible at all times
- Allow for tokenization of in- and outgoing product side streams, required for detailed tracing but also for circular economy
- Allow for configurable activity tracing and its granularity level
- Differentiation between value and price
- Develop solution with operational cost and usability in mind
- Define ways to implement solution into real supply chains