# Conditioned goods Proof of Concept description

## Introduction

The goal of the Conditioned Goods use case is to both **increase the visibility of the product’s conditions through the supply chain** and to **decrease the ecological footprint of the goods’ transportation**. Both goals are expected to be achieved by increasing the supply chain transparency and traceability which in turn would allow for a better sharing of data across the chain and therefore management of the conditioned goods.

The objective is to develop an information system that accurately tracks a selected set of characteristics of the goods such as temperature or humidity. Information extracted will enable for a more sound management of the energy used for the quality desired by the producer and the final customers.

The goal of this proof of concept is to proof the technical feasibility of the Conditioned Goods use case and to provide a test implementation to perform experiment 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.

## Research question

What is the added value of real-time temperature data across the chain?

To what level of detail can we trace the conditions of end-to-end product across a supply chain using blockchain technology?

How can we connect the factory and transport numbers to the customer?

How can we use this system to feed an energy management model decreasing the energy use for the transportation of the goods at the requested quality?

What is the impact of using those developments running on blockchain technologies to reduce the ecological footprint of the transportation of the goods across the chain?

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

## Passed achievements

### Feasibility study

During the first research we did with two groups of students, it was found that the combination of blockchain and sensors technologies could have a great impact on the temperature management of the goods across the chain. That being said, some more research is needed for the involved parties to be sure of the investments needed to implement such technologies.

A potential change on the ecological and environmental impact of the whole chain could also be envisioned, ensuring a good handling of the products, for the best quality while using as little energy as possible.

### Sensor experiments

Over the course of the last year, several experiments with sensors from different parties have been made to make a first analysis of the current status of the chain. We worked on two different chains following the process, one from Oosterbierum (OBM) to Bergen op Zoom (BOZ) and the other from Broekhuizenvort (BHV) to BOZ. Find the chains below. Diagram, schematic

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Several experiences were made from the boxing at LMW (arrow up) until the dock at Lineage (arrow down). Many recordings have been made on different days and at different places of the trucks. You can find some of them in the appendix 1 of this document.

### Blockchain-based web-application development

For two semesters, groups of students worked on the development of a blockchain-based web-application that could serve as a linking platform between the sensors recording the temperature and the different entities in the chain. Their application, developed on Hyperleger Fabric (HLF) is now a prototype able to send messages to the different entities based on the temperatures received. For the next stages of development we will need to look with a critical look at the application developed and its blockchain. The aim will be to make sure that we use the right blockchain for the right problem, and not that we keep using the already developed web-based application just because it is there already.

## Envisioned solution

### Solution summary

The envisioned solution focuses on the tracking of the goods across the chain with the use of sensor technology. This therefore needs two types of developments.

Firstly we need to determine the best sensor for the intended use and objectives. These sensors will be connected, meaning that they can communicate back and forth with a system enabling a seamless information visibility. The sensor, placed as close to the product as possible, is then going across the chain together with the goods until the end customer, making sure that a continuous flow of information is maintained. With the correct amount of sensors on the right amount of goods packaging units, we can ensure that the desired conditioned is maintained thanks to a trustworthy system (we prevent here the “bullshit in” of many information systems).

In parallel, we need to develop an information system that will be able to receive information from the sensors themselves and to make them accessible to a pre-defined number of roles across the chain such as producer, transporter, cold storage and so on. This information system, developed on a blockchain, will enable the data stored this way to be immutable and verifiable. With roles to be created for each relevant parties of the chain, every supply chain partner with an access will be able to view the logs from the sensors displaying the conditions under which the goods were transported, and this for each new transport (or defined period in the scoping of the use case).

### Solution definition

Define the phases of the solution

## Opportunities with this use case

* HAN hogeschool can help us with sensors
* TU Dortmund can help us with research capacity
* Havi potentially interested to join the use case
* Partners’ own SDG goals and operational visions
* Horizon EU call for next year could be based on this project
* TU Delft researcher with similar case

## Milestones and goals

### Until June 2022

Until the month of June 2022, we need, as a use case consortium to prepare the use case for it to become an interesting project for the different parties involved. This means that we need to look for and analyze the actual impact, investment and ROI (both € & SDG) that the project would have on the entities and their operations.

## Use case criteria

### Addressing complex organizational network problems

### Involvement of SMEs

### Contribution to circular economy and/or sustainability

### Potential global adaptability

### Contribution to Top Sector action lines

## Scope

The studied scope of the use case is from the producer (LWM) to the cold storage (Lineage) via DLG, following the red rectangle bellow. It is however intended for the technology to be deployed on the entire chain, for all entities of the chain to take full benefit of the whole supply chain, from the producer to the customer.

Diagram, schematic

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## Appendix

### Sensor experiment







